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United States
Department of
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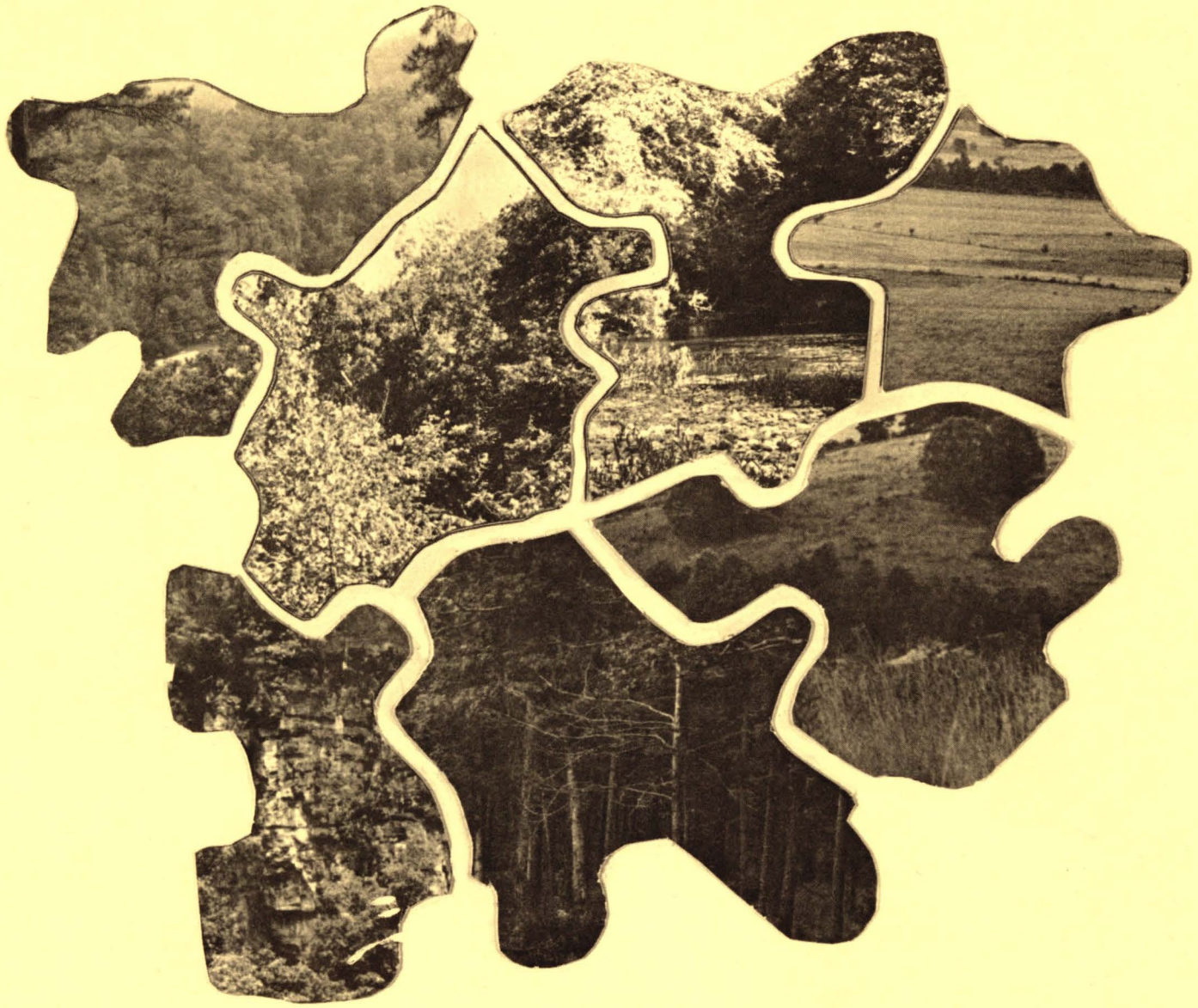
Forest
Service

Resource Planning
and Management

Rolla, Missouri

Ecological Land Classification Terrestrial Subsystem

A Basic Inventory System for Planning and Management on the Mark Twain National Forest



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Reply to: 1920

Date: November 1, 1982

Dear Colleague:

Enclosed is a copy of the publication "Ecological Land Classification Terrestrial Subsystem - A Basic Inventory System for Planning and Management on the Mark Twain National Forest."

This publication describes the concepts of the system. It is supported by nine Unit Reports, each of which describes one of the proclamation units of the Mark Twain National Forest.

The Terrestrial Subsystem has been developed by an interdisciplinary team of Forest resource specialists. We have utilized the State of Missouri Natural Divisions System in describing the Forest's terrestrial system. By doing so we hope the two will be interactive. The system has been implemented on the Forest for several years as various phases of it were developed. Its parameters are being inventoried and pre-mapped projection validated by our annual compartment examination process.

Supporting Unit Reports contain resource interpretations for each Ecological Land Type. These interpretations reflect inherent capability to produce various resources from specific ELT's. They also identify the ELT's ability to absorb physical and visual disturbance.

This system is playing a major role in resource management coordination on the Mark Twain. It has been incorporated into our new Forest Plan as a primary geographical focus for resource program allocation. We also use it as a base line reference to analyze resource opportunities and trade-offs in the preparation of coordinated project level prescriptions.

This system was developed based on the best estimates and information we had reasonably available to us. The Unit Reports are by no means complete. We anticipate improving them through application and continued evaluation. Suggestions for the improvement of the system are welcome.

Sincerely,

For B. Eimbinder

LEON CAMBRE
Forest Supervisor

Enclosure

FS-6200-11 (8-80)

ECOLOGICAL LAND CLASSIFICATION

TERRESTRIAL SUBSYSTEM

MARK TWAIN NATIONAL FOREST

MISSOURI

A BASIC INVENTORY SYSTEM

FOR

PLANNING AND MANAGEMENT

By

Mack R. Miller
Soil Scientist

December, 1981

U. S. Department of Agriculture
Forest Service
Eastern Region

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Preface

The management of National Forest System lands today requires that management decisions be based on the most reliable and comprehensive information available. Single resource inventories, such as soils, timber, and range, used in the past, often did not furnish all the data needed or allow for interpretations based on the interaction of several resources. Sizes, shapes, and levels of information between the various single resource inventory mapping units often varied considerably, making it difficult, if not impossible to form a uniform planning base.

This paper describes a comprehensive system of terrestrial land classification that has been developed for the Mark Twain National Forest. The system brings together important resource variables and their interactions, so that land capabilities and suitabilities can be better understood.

Eight levels, or inventory intensities, are identified to provide basic land resource information at various planning levels. The six higher levels are defined in this report.

INTRODUCTION

The capability of land to produce various natural resource oriented goods and services as well as its suitability for such production are critical elements in making sound land-use decisions. They provide a basis on which to predict and compare resource outputs, production cost and environmental changes between the various alternative solutions. Because of the complexity of the land and the interaction between the various resources, units of land common to all resources are needed on which to logically base total land capabilities.

Over the past several years the Mark Twain National Forest has developed and tested several land classes, at various levels, in an effort to satisfy this need. In 1979 the Regional Forester issued a directive stating the Eastern Region's policy and responsibility for the development and implementation of an Ecological Classification System (Chapter 30, Ecological Classification, Eastern Region, Land and Resource Management Planning Handbook, FSH 1909.21). The directive provided for two subsystems, Aquatic and Terrestrial, within the overall system. It structured a hierarchical system relating to use, developed criteria and definitions for the three upper levels and gave guidelines for the development of intermediate and lower levels, by the Forest for the Terrestrial subsystem.

This report describes the Terrestrial Ecological Classification System, as thus far developed, for the Mark Twain National Forest within the hierarchical framework of the Eastern Regional System. It gives a brief review of major characteristics of the system relating to use, reviews and further defines the upper levels, and presents criteria and definitions for three intermediate levels. Criteria for the lower levels will be developed and presented as their relevance to sound resource management decision making requires.

The system draws heavily on previously developed land classification systems throughout the country. Other information concerning the land resources was drawn fr published and unpublished materials and personal knowledge. Additional information is needed to further refine or improve the reliability of some criteria. An effort is made to document all information sources so users can judge for themselves the reliability of the system and the limitations of its use. This report at best represents the present state of knowledge. As the system is further tested and new information becomes available it will be revised or updated.

THE SYSTEM [1/]

The system, as developed for the Eastern Region, stratifies and classifies the lands within the National Forest system at eight different levels to provide land capability information at various planning levels. It is a holistic system in that all three critical elements (deemed critical by most authorities) soils, landtype or geomorphology, and vegetation, are considered in delineating a particular level. However, each critical element may not receive equal weight at all levels and additional elements may be used at some or all levels if needed. The system is hierarchical, integrative, ecological, and visible. Each of these four characteristics is discussed below.

1. Hierarchical. Land units are identified, mapped, and interpreted at more than one intensity. The hierarchical levels represent a time-space gradient, i.e., large and relatively permanent entities to small and relatively short-lived entities.

This characteristic permits a close association between the inventory system and a hierarchical planning process. It leads to inventory efficiencies because data collection can be adjusted to the data demand of the planning process.

2. Integrative. Land units identified in an Ecological Classification System have ecological significance for a wide range of natural resources and land features. These land units thus serve as a common geographic base for description and interpretation of several resources.

This characteristic is important because management direction and impact are controlled by the ecological interaction of resources acting in concert and it is desirable to express this integration as much as possible at the inventory stage. The "traditional" method of resource inventory for planning has each resource inventoried independently. Integrating several inventories fell to planners. These several inventories separated (on paper) resources, the uses of which are not separable.

Detailed separate resource inventories may continue to be necessary for project planning, analysis and choice.

Ecological Classification System development is based on the premises that (a) natural resources are closely associated when viewed from an ecosystem standpoint, (b) land units representing a definite range of natural resources properties (core characteristics) can be identified and mapped, (c) land capability/suitability should be determined considering combinations of several natural re-

[1/] Condensed from USDA Forest Service, Region 9. 1979.

Figure 1. Ecological Classification System Levels

ECS LEVEL	TYPICAL SIZE	MAP SCALE	ECS GROUP	USED FOR
SUBREGION	Two or more states	1:4 million		
PROVINCE	Multistate-Thousands of square miles	1:2 million-1:4 million	Upper Levels	National Planning
SECTION	Thousands of square miles	1:1 million-1:5 million		
SUBSECTION	Hundreds of square miles	1:120,000-1:500,000		
LANDTYPE ASSOCIATION	1 to 10's of square miles	1:32,000-1:250,000	Intermediate Levels	Forest Planning
ECOLOGICAL LANDTYPE	1/10 to 1 square miles	1:15,840-1:60,000		
LANDTYPE PHASE	6 to 64 acres	1:7,500-1:15,840	Lower Levels	Project Planning
SITE	A point usually less than 6 acres	Less than 1:6,000		

sources, and (d) units of land rather than individual resources are the objective of management.

3. Ecological. The focus is on units of land (ecosystems) as integrators of several natural resources. Since core components are normally highly interrelated, a change in one of the core components (used to identify a unit) over a geographic area can be expected to be associated with changes in other core components. In essence, aspects of most natural resources (core components) are approached as a part of a larger whole.

4. Visible. Land units defined in the system are generally visible to the land manager. An effort is made to insure that the higher level (more general) land units are familiar to, or can be easily understood by the land manager.

Figure 1 shows the eight levels recognized in the Eastern Region's Ecological Classification System: their names, typical size, and appropriate map scale. The table also shows how the eight levels fall into three broad groups -- upper, intermediate, and lower -- which pertain to National, Forest, and Project planning, respectively.

THE UPPER LEVELS [1]

The upper levels are Subregion, Province, and Section. They are physiographic areas of land that have been mostly established in literature. Their primary function is to set regional perspectives to facilitate communication and correlation. Following are criteria, names, and definitions for each of the three levels for the Mark Twain. Figure 2 shows the portion of the Forest situated within each land unit.

SUBREGION

Subregions are geographic groupings of National Forests, covering two or more States. They reflect the principal kinds of landforming processes active in Region 9, i.e., continental glaciation, fluvial (water) erosion, and Alpine and continental glaciation. The Mark Twain National Forest lies within the portion of the region having fluvial erosion landforming process, called the Southern Forests Subregion (Fig. 2). Definition of the Southern Forest Subregion is given below.

Definition

The Southern Forests Subregion lies beyond the southern limit of continental glaciation. Lands occupied by the National Forests are basically stream-dissected edges of a series of low plateaus. The result is a combination of ridges and valleys of various degrees of expression that control the land-use pattern. Remnants of plateau surfaces are scattered through the area but most of these flatter lands are in private ownership.

Bedrock is mostly shales, limestones, and sandstones, although granites are conspicuous in the St. Francois Mountains in Missouri. Climate is classified as humid, warm-summer continental, meaning that summer months have temperature averages above 80 degrees F. Vegetation is dominated by a rich mixture of deciduous trees. The western part is covered by oak-hickory forests, the central part by what Shelford (1965) calls tulip-oak forests, and the east is maple-birch-basswood, maple-beech-hemlock, Appalachian oak forests.

PROVINCES

A Province is a part of a Subregion, covering thousands of square miles. Provinces correspond to physiographic units delineated in Fenneman's (1938) work. Vegetation within a Province is uniform at the level illustrated by Bailey (1976).

Six Provinces are present in the Southern Forests Subregion: Appalachian Plateau, Ridge and Valley, Ozark Plateau, Interior Low Plateau, Central Lowland, and Coastal Plain. Mark Twain NF lands fall within two of these provinces: Ozark Plateau Province and Central Lowland Province. Provinces are shown in Figure 2. Definitions of the Ozark Plateau and Central Lowland Provinces are given below.

Definitions

1. Ozark Plateau Province. The Mark Twain National Forest (except for Cedar Creek Ranger District) is in this province. The Ozark Plateau is a dissected upland. The St. Francois Mountains rise above the plateau near its eastern edge, giving the area an asymmetrical dome appearance. Forests are concentrated primarily on the slopes of the St. Francois Mountains and ridgelands formed by dissection of the plateau margin. Cherty, droughty soils are a conspicuous feature of the Ozark landscape. The area receives 40-48 inches of rain and has 180-210 frost-free days. Three Sections are recognized within the Ozark Plateau Province. Kuchler (1964) places the forest in the oak-hickory and oak-hickory-pine types.

2. Central Lowland Province. A small part of this large Province forms the northern part of the Shawnee National Forest and the Cedar Creek Unit in Missouri. This area differs from all other parts of the Southern Forests Subregion by being mantled with glacial till.

SECTIONS

Sections are specific, non-repetitive areas which are established in the literature; they have been set up by the Regional Forester to set regional perspective, and are used for national-level planning. Sections are based on Fenneman's physiographic areas (at a finer level than Provinces), on Kuchler's (1964) potential natural vegetation, and on generalizations about soils (igneous vs. sedimentary, etc.). The Mark Twain National Forest is situated within three Sections: the St. Francois Mountains and Salem Plateau Sections in the Ozark Province; and the Dissected Till Plain Section in the Central Lowland Province. [2]

[1] Condensed from USDA Forest Service, Region 9. 1979.

[2] USDA Forest Service, Region 9 (1978) shows a small portion of the Mark Twain National Forest located in a fourth section, the Springfield Plateau Section. Since this small area appears to be gradational or very similar to the Salem Plateau Section, the boundaries between the two Sections are redefined to include this small area in the Salem Plateau Section.

Definitions

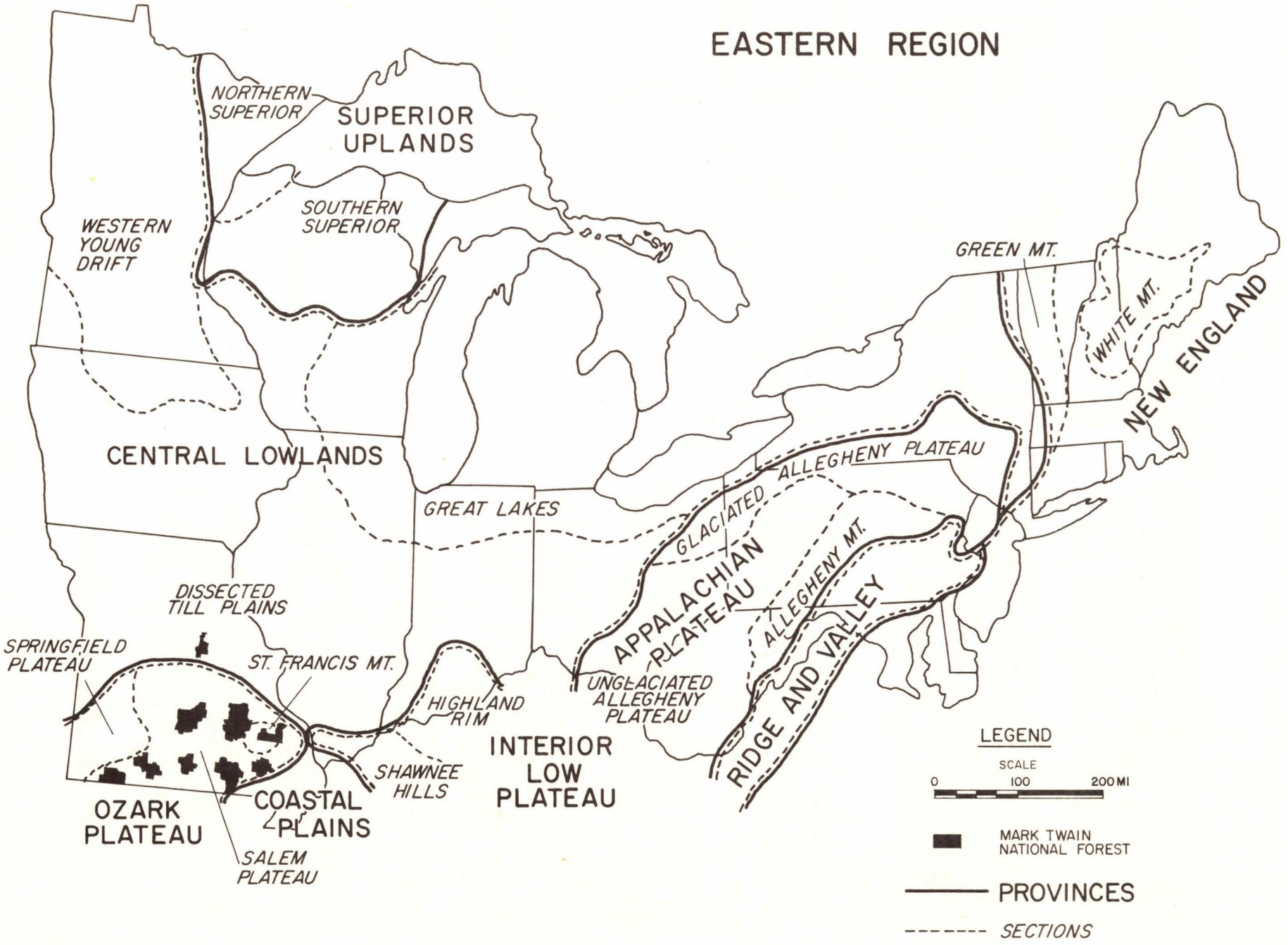
1. The St. Francois Mountains Section is underlain by granite and has local relief up to 600 feet. Limestone, which once covered the whole granite surface, is present in many valley bottoms leading up into the Section. Soils developed on the granite are shallow on slopes and have low fertility. Black, post, and blackjack oaks and pine are the primary forest types. In the mineralized limestone associated with these granite hills, lead, zinc, and associated metals are mined.

2. The Salem Plateau Section is underlain by gently dipping, lower to middle Paleozoic sedimentary rocks, primarily limestone and dolomite. The Section shows extensive development of sinkholes and other karst features.

Much of the land is rough, steep, and forested with oak and pine. Cedar glades occur locally. Relief is somewhat lower than in the St. Francois Mountains Section. Residual soils are silty, contain clay, and commonly have a high chert content. Lead, zinc, and associated minerals are mined in parts of the Section. Springs are numerous and groundwater, though hard, is abundant in limestone aquifers.

3. The Dissected Till Plains Section is underlain by Pennsylvanian sedimentary rock, primarily limestone and shales, mantled with Kansan glacial drift materials to a depth of 20 to 40 feet. Much of the land is gently rolling to moderately steep. Local relief is commonly less than 150 feet. Soils are generally deep. Drainage is often restricted due to lack of relief and clayey subsoils. Tall grass prairie occupied much of the area prior to settlement with oak-hickory forests restricted to the steep slopes. Presently most of the area is in agricultural crops with small scattered areas of forest remaining on the rougher land.

FIGURE 2. PROVINCES AND SECTIONS.



SUBSECTIONS

Subsections, the highest of the intermediate levels, fit within and/or re-define the regionally established Sections. They are geographic areas of land hundreds of square miles in size that are significantly different from one another in at least one of the core characteristics, i.e., physiography, geology, soils, or potential natural vegetation.

Five Subsections, that roughly correspond to Thom and Wilson's (1980) "Natural Areas Sections of Missouri", are recognized for the Mark Twain National Forest. Names and definitions for the Subsections are given below. Figure 3 shows the portion of the Forest situated within each Subsection and Figure 5 shows placement of the Subsections within the hierarchical scheme.

CRITERIA

No specific criteria are defined for Subsections; however, differences in land surface form, geology, soils and natural vegetation were used as primary criteria in delineating and defining Subsections for the Mark Twain.

NAMES AND DEFINITIONS

Subsection names are the same as those for the Natural Areas Sections developed by Thom and Wilson. They are named for physiographic features within Missouri, i.e., St. Francois Mountains, Upper Ozarks, Lower Ozarks, White River, and Eastern Glaciated Plains.

Subsections are defined in terms of their geographic location within the Section, topography or typifying landforms, characteristics of surface bedrock or formation, dominant soils, and vegetation. The five Subsections are defined as follows: (More detailed descriptions of each can be found in Thom and Wilson, 1980).

1. The Eastern Glaciated Plains Subsection is the only part of the Forest where the geological surface materials consisted of glacial till.

Potential natural vegetation (Kuchler, 1964) is a mosaic of Oak-Hickory Forest and Bluestem Prairie. Soils are generally deep, clayey, somewhat poorly to moderately well drained.

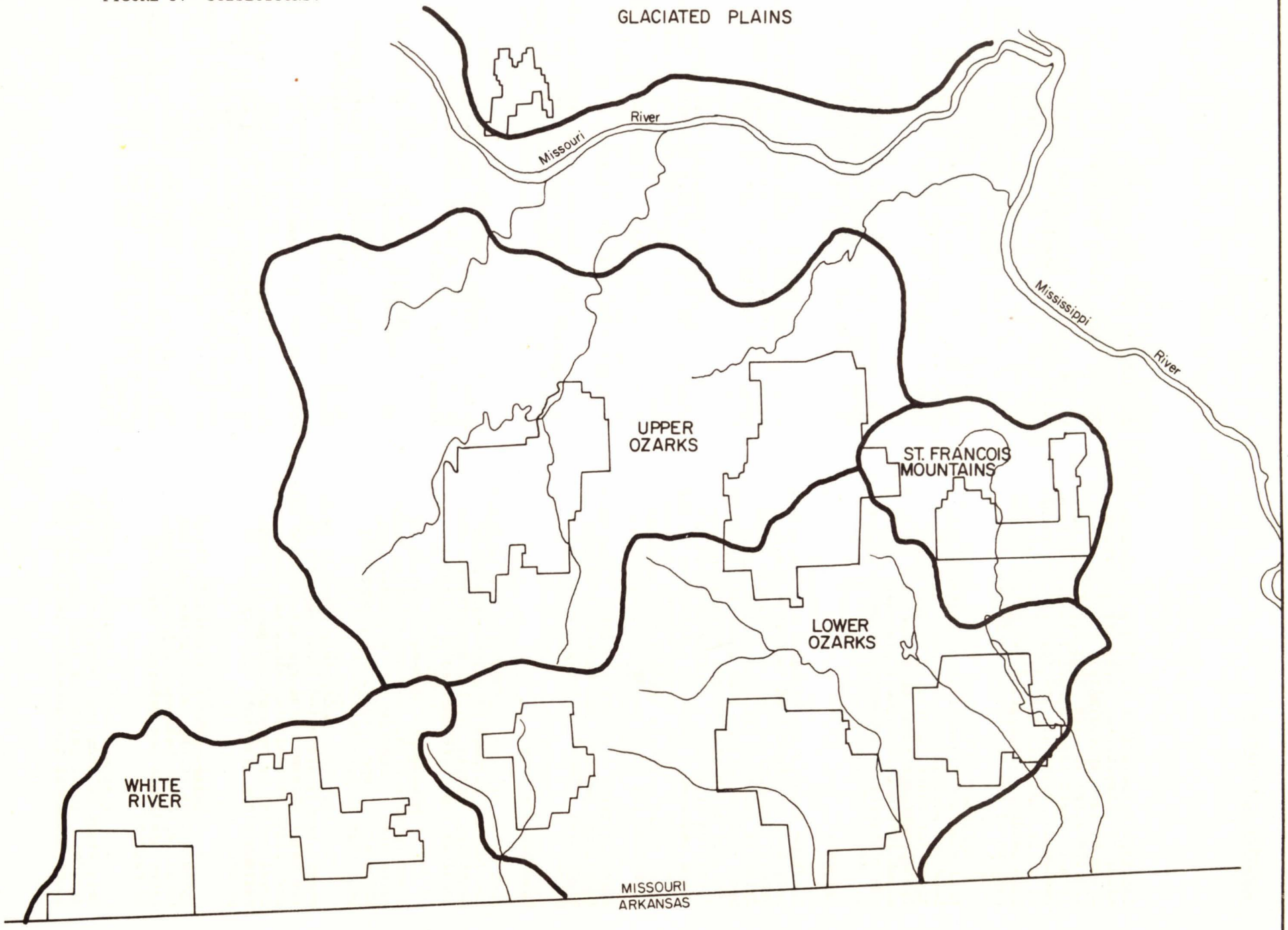
2. The St. Francois Mountains Subsection stands apart by virture of the Precambrian igneous rocks which are exposed. It is characterized by conical mountains and broad valleys with Oak-Hickory-Pine Forest. Moderately deep to deep, stony and cherty well to excessively drained soils are common.

3. The Upper Ozark Subsection has mostly Ordovician-aged cherty dolomites and sandstones; the topography is gently rolling to moderately dissected. Both Oak-Hickory and Oak-Hickory-Pine forests are found here; however, Oak-Hickory predominates. Soils are often deep to moderately deep, clayey or cherty and moderately well to excessively drained.

4. The Lower Ozark Subsection has soils derived from cherty dolomites and sandstones, but more sandstone in general than the Upper Ozarks. Most of the Subsection is highly dissected, with smaller areas of gently rolling landscapes and small plains on upland plateau remnants. This Subsection is the center of the Missouri pine-bearing lands, with Oak-Hickory-Pine Forests over most of the area and Oak-Hickory forests around the edges. Soils are deep, very cherty and well to excessively drained.

5. The White River Subsection rests upon Jefferson City dolomite, with younger Mississippian limestone on the ridges. The most characteristic feature of the Subsection is the abundance of limestone "glades" with bluestem-redcedar or shrubby vegetation. Topography is highly dissected. Soils are most often shallow to moderately deep, stony and well to excessively drained.

FIGURE 3. SUBSECTIONS.



LANDTYPE ASSOCIATIONS

Landtype Associations (LTA's) are subdivisions of Subsections. They are recurring areas of land approximately 5,000 to 100,000 acres in size, that are fairly uniform in their land surface form, subsurface geological materials and features, patterns of soils, and potential natural vegetation. Each Landtype Association exhibits a unique pattern of the Ecological Landtypes (Figs. 6-32).

Following are classification criteria for Landtype Associations and names and definitions for those identified on the forest. The approximate location of each LTA is shown in Figure 4. Their placement within the hierarchical scheme is shown in Figure 5.

CRITERIA

Landtype Association criteria are characteristics of the land used to divide the more general Subsections into more finite areas. Criteria selected are those which appear best to form uniform land associations which could be delineated by use of existing information with only a minimum of field work being required. Criteria established in the literature are used in most cases. In some cases these criteria are modified somewhat to better fit local needs and conditions.

Three criteria elements are used: land surface form, geology, and potential natural vegetation. These criteria are defined below.

Land Surface Form

Four types of land surface form are recognized for the purpose of delineating LTA's: Mountains, Breaks, Hills, and Plains. The landform types are defined as follows:

1. Mountains. Moderately steep to steep uplands within the St. Francois Mountains area. Local relief is greater than 450 feet. Slope gradients are generally less than 30 percent.

2. Breaks. Moderately steep to very steep, highly dissected lands adjacent to the major streams. Valleys are deep and narrow; ridge systems are narrow and continuous. Local relief is between 300 and 450 feet. Maximum slope gradients are more than 30 percent.

3. Hills. Gently sloping to steep uplands that occupy narrow stream divides. Local relief is between 150 and 300 feet. Slope gradients are generally less than 30 percent.

4. Plains. Gently sloping to moderately steep uplands that occupy broad stream divides. Local relief is less than 150 feet. Slope gradients are generally less than 15 percent.

Geology (Soil Parent Materials)

At the Landtype Association level of land classification, "geology" refers to the soil-forming material or soil parent material, which is the unconsolidated and more or less chemically weathered mineral or organic matter from which soils form. It is used as a criterion for Landtype Associations delineation because (1) soil associations were expected to correspond to it, and (2) it influences vegetation (Fletcher and McDermott, 1957).

Six classes of soil parent material are recognized for the purposes of delineating LTA's. The six classes are defined as follows:

1. Sandstone. Dominant soil parent material consists of interbedded cherty dolomitic limestone and sandstone. Sandstone layers contribute at least 35 percent of the total.

2. Limestone. Dominant soil parent material consists of cherty dolomitic limestone. Sandstone layers contribute no more than 35 percent of the total. (These "limestones" usually contain enough $CaMg(CO_3)_2$ to be called "dolomites", but the more familiar term has been used for clarity.)

3. Loess. Dominant soil parent material consists of loess (wind-deposited particles) at least 3-5 feet deep over interbedded cherty dolomitic limestone and sandstone.

4. Felsite. Dominant soil parent material consists of felsites and cherty dolomite. Felsite is an igneous rock, finer grained than granite.

5. Granite. Dominant soil parent material consists of granite.

6. Till. Dominant soil parent material consists of Kansan glacial till over limestone and shale.

Potential Natural Vegetation

Potential natural vegetation (PNV) is defined as "the vegetation that would exist today if man were removed from the scene and if the resulting plant succession were telescoped into a single moment" (Kuchler, 1964).

The following four characterizations of the potential natural vegetation types are drawn from Kuchler (1964), but are refined to fit Missouri rather than the eastern United States.

1. Oak-Hickory-Pine Forest (Quercus - Carya - Pinus)

Physiognomy:
Medium tall to tall forest of broadleaf deciduous and need leleaf evergreen trees.

Dominants:
Black oak
(Quercus velutina)
White oak
(Quercus alba)
Post oak
(Quercus stellata)
Hickory
(Carya spp.)
Shortleaf pine
(Pinus echinata)

Other Components:
Northern red oak
(Quercus rubra)
Southern red oak
(Quercus falcata)
Scarlet oak
(Quercus coccinea)
Blackjack oak
(Quercus marilandica)
Shumard oak
(Quercus shumardii)
Blackgum
(Nyssa sylvatica)
Flowering dogwood
(Cornus florida)
Persimmon
(Diospyros virginiana)

2. Oak-Hickory Forest (Quercus - Carya)

Physiognomy:
Medium tall to tall broadleaf deciduous forests.

Dominants:
Black oak
(Quercus velutina)
White oak
(Quercus alba)
Post oak
(Quercus stellata)
Hickory
(Carya spp.)
bitternut, shagbark

Other Components:
Northern red oak
(Quercus rubra)
Southern red oak
(Quercus falcata)
Blackjack oak
(Quercus marilandica)
Shumard oak
(Quercus shumardii)
Chinkapin oak
(Quercus muhlenbergii)
Hickory
(Carya spp.)
pignut, black,
mockernut
White ash
(Fraxinus americana)
Black walnut
(Juglans nigra)
American basswood
(Tilia americana)
American elm
(Ulmus americana)
Black cherry
(Prunus serotina)

3. Cedar Glades (Juniperus - Quercus - Sporobolus)

Physiognomy:
Low to medium tall open grassland with scattered needleleaf evergreen shrubs and groves of low to medium tall broadleaf deciduous trees.

Dominants:
Eastern redcedar
(Juniperus virginiana)
Post oak
(Quercus stellata)
Chinkapin oak
(Quercus muhlenbergii)
Sugarberry
(Celtis laevigata)
Winged elm
(Ulmus alata)
Baldgrasses
(Sporobolus neglectus,
S. vaginiflorus)
Little bluestem
(Andropogon scoparius)
Blackeyed susan
(Rudbeckia missouriensis)

Other Components:
Big bluestem
(Andropogon gerardi)
Poverty grass
(Aristida longispica)
Sideoats grama
(Bouteloua curtipendula)
Indian grass
(Sorghastrum nutans)
Sandwort
(Arenaria patula)
Hairy lip-fern
(Cheilanthes lanosa)
Croton
(Croton spp.)
Leavenworthia
(Leavenworthia spp.)
Palafoxia
(Palafoxia callosa)
Prairie clover
(Petalostemum purpureum)
Scurf pea
(Psoralea spp.)

Sedum
(Sedum pulchellum)
Coneflower
(Echinacea spp.)
Trelease's larkspur
(Delphinium treleasei)
Sunflower
(Helianthus spp.)
Penstemon
(Penstemoncobaea)

4. Bluestem Prairie (Andropogon - Panicum - Sorghastrum)

Physiognomy:
Dense vegetation of tall grasses and many forbs. (In Missouri, occurs as part of a mosaic with Oak-Hickory Forest.)

Dominants:
Little bluestem
(Andropogon scoparius)
Big bluestem
(Andropogon gerardi)
Switch grass
(Panicum virgatum)
Indian grass
(Sorghastrum nutans)

Other Components:
Grasses - Sideoats grama
(Bouteloua curtipendula)
Junegrass
(Koeleria cristata)
Panic grasses
(Panicum spp.)
"Baldgrass"
(Sporobolus heterolepis)
Bluejoint grass
(Calamogrostis canadensis)

Forbs - Lead plant
(Amorpha canescens)
Pussytoes
(Antennaria neglecta)
Heath aster
(Aster ericoides)
Smooth aster
(Aster laevis)
False indigo
(Baptisia leucantha & B. leucophaea)
Fleabane
(Erigeron stigosus)
Bedstraw
(Galium tinctorum)
Sunflower
(Helianthus grosseserratus)
Blazing star
(Liatris aspera, L. punctata, L. scarriosa)
Phlox
(Phlox pilosa)
Scurf pea
(Psoralea esculenta, P. tenuiflora)
Wild rose
(Rosa spp.)
Compass plant
(Silphium laciniatum)
Goldenrods
(Solidago spp.)
Smoke tree
(Cotinus obovatus)
Ashe juniper
(Juniperus ashei)
Persimmon
(Diospyros virginiana)
Gum bumelia
(Bumelia lanuginosa)
Georgia hackberry
(Celtis tenuifolia)
Redbud
(Cercis canadensis)
Blackjack oak
(Quercus marilandica)
Aromatic sumac
(Rhus aromatice)
Supplejack
(Berchemia scandens)
Greenbrier
(Smilax spp.)

NAMES AND DEFINITIONS

System names for Landtype Associations are based on their three major criteria elements: potential natural vegetation, land surface form, and dominant soil parent material. Potential natural vegetation type is first followed by land surface form, and soil parent material last, i.e., Oak-Hickory Plains (limestone). LTA's are defined in terms of their criterial elements. Eighteen LTA's are recognized on the Forest. Their names and definitions are as follows:

	Name	Symbol	Definitions
1.	Oak-Pine Plains (granite)	OPP(g)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Plains landform. 3. Granite soil-forming materials.
2.	Oak-Pine Plains (limestone)	OPP(l)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Plains landform. 3. Limestone soil-forming materials.
3.	Oak-Pine Plains (sandstone)	OPP(s)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Plains landform. 3. Sandstone soil-forming materials.
4.	Oak-Hickory Plains (limestone)	OHP(l)	Areas of land having: 1. Oak-Hickory potential natural vegetation. 2. Plains landform. 3. Limestone soil-forming materials.
5.	Oak-Bluestem Plains (till)	OBP(t)	Areas of land having: 1.Oak-Hickory & Bluestem prairie mosaic potential natural vegetation. 2. Plains landform. 3. Limestone soil-forming materials.
6.	Oak-Pine Hills (limestone)	OPH(l)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Hills landform. 3. Limestone soil-forming materials.

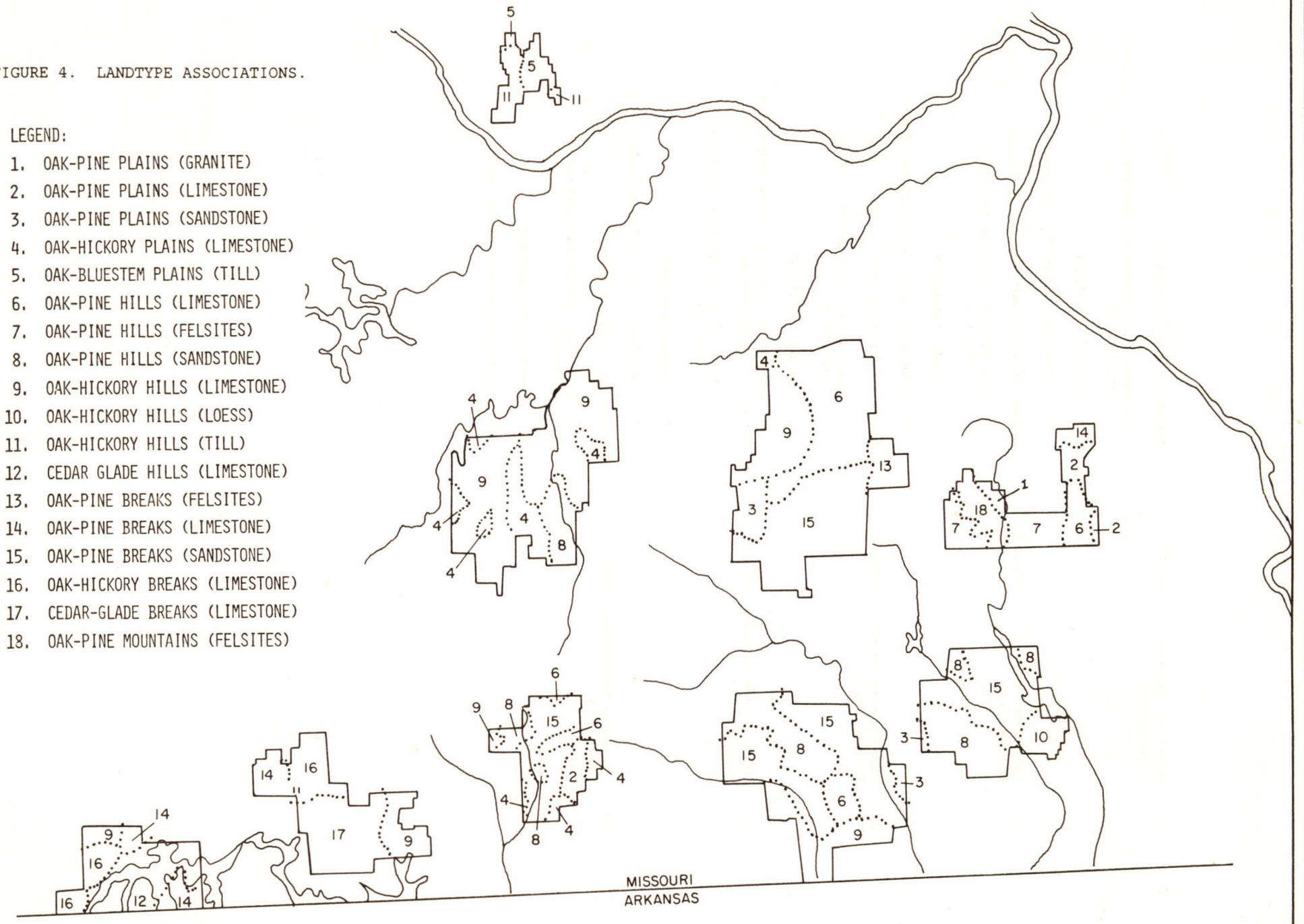
7.	Oak-Pine Hills (felsite)	OPH(f)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Hills landform. 3. Felsitic soil-forming materials.
8.	Oak-Pine Hills (sandstone)	OPH(s)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Hills landform. 3. Sandstone soil-forming materials.
9.	Oak-Hickory Hills (limestone)	OHH(l)	Areas of land having: 1. Oak-Hickory potential natural vegetation. 2. Hills landform. 3. Limestone soil-forming materials.
10.	Oak-Hickory Hills (loess)	OHH (lo)	Areas of land having: 1. Oak-Hickory potential natural vegetation. 2. Hills landform. 3. Loess soil-forming materials.
11.	Oak-Hickory Hills (till)	OHH(t)	Areas of land having: 1. Oak-Hickory potential natural vegetation. 2. Hills landform. 3. Glacial till soil-forming materials.
12.	Cedar Glade Hills (limestone)	CGH(l)	Areas of land having: 1. Cedar Glade potential natural vegetation. 2. Hills landform. 3. Limestone soil-forming materials.
13.	Oak-Pine Breaks (felsite)	OPB(f)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Breaks landform. 3. Felsitic soil-forming materials.

14.	Oak-Pine Breaks (limestone)	OPB(l)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Breaks landform. 3. Limestone soil-forming materials.
15.	Oak-Pine Breaks (sandstone)	OPB(s)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Breaks landform. 3. Limestone soil-forming materials.
16.	Oak-Hickory Breaks (limestone)	OHB(l)	Areas of land having: 1. Oak-Hickory potential natural vegetation. 2. Breaks landform. 3. Limestone soil-forming materials.
17.	Cedar Glade Breaks (limestone)	CGB(l)	Areas of land having: 1. Cedar Glade potential natural vegetation. 2. Breaks landform. 3. Limestone soil-forming materials.
18.	Oak-Pine Mountains (felsite)	OPM(f)	Areas of land having: 1. Oak-Pine potential natural vegetation. 2. Mountains landform. 3. Felsitic soil-forming materials.

FIGURE 4. LANDTYPE ASSOCIATIONS.

LEGEND:

1. OAK-PINE PLAINS (GRANITE)
2. OAK-PINE PLAINS (LIMESTONE)
3. OAK-PINE PLAINS (SANDSTONE)
4. OAK-HICKORY PLAINS (LIMESTONE)
5. OAK-BLUESTEM PLAINS (TILL)
6. OAK-PINE HILLS (LIMESTONE)
7. OAK-PINE HILLS (FELSITES)
8. OAK-PINE HILLS (SANDSTONE)
9. OAK-HICKORY HILLS (LIMESTONE)
10. OAK-HICKORY HILLS (LOESS)
11. OAK-HICKORY HILLS (TILL)
12. CEDAR GLADE HILLS (LIMESTONE)
13. OAK-PINE BREAKS (FELSITES)
14. OAK-PINE BREAKS (LIMESTONE)
15. OAK-PINE BREAKS (SANDSTONE)
16. OAK-HICKORY BREAKS (LIMESTONE)
17. CEDAR-GLADE BREAKS (LIMESTONE)
18. OAK-PINE MOUNTAINS (FELSITES)



Ecological Landtypes (ELT's) are reoccurring subdivisions of the more general Landtype Associations. They are the basic and lowest level within the system intermediate levels. They vary from approximately one to one hundred acres in size. Because of their size and uniformity, reliable quantitative capability values for the various resources can be assigned to each, making them very useful units of land for forest planning. A summation of their capabilities can be made to derive more general capability values for the higher levels used in larger land area plans. Typical landform patterns for Ecological Landtypes are shown in Figures 6 through 32.

Following are classification criteria for Ecological Landtypes, and names and definitions for those identified on the Forest.

CRITERIA

Three major kinds of criteria are used in delineating Ecological Landtypes. They are landform, soils, and vegetation. Each is discussed and defined below.

Landform

The landform criterion is important because it provides an easily recognizable area of land within the landscape. It is also closely related to slope characteristics which often limit land use or affect soil moisture regimes and the time and intensity in which direct sunlight acts on the land surface. These characteristics give rise to two sub-criteria used in defining landforms: slope gradient and slope aspect, respectively. Slope length and shape did not appear to have significance as criteria at the Ecological Landtype level; however, they do appear to be important at the lower Ecological Landtype Phase level. Nine landform types are recognized. Each is listed and defined, inclusive slope gradients ranges are given, and slope aspect classes are described below.

Ridge	A narrow, elongated crest of a hill or mountain or an interfluve. Slopes: 0-8 % (some as steep as 10%).
Flat	A level or nearly level area of land marked by little or no relief. (Locally includes nearly level to gently rolling broad ridges.) Slopes: 0-8% (some as steep as 10%).
Sideslope	The steeper portion of a hillslope, occupying the area below the summit and above the toeslope. Slopes: 8-99%.
Toeslope	The depositional surface at a hillslope base, transitional to lowland. Slopes: 0-14%.
Bench or Terrace	A long narrow, relatively level, or gently inclined, strip or platform of land, bounded by steeper slopes above and below. Slopes: 0-4%.
Floodplain	The strip of relatively level or smooth land adjacent to a stream channel and covered with water when the stream overflows its banks. Slopes: 0-4%.
Upland Waterway	A long narrow, relatively level, or gently inclined strip of land at the bottom of a "hollow" over which excess water flows from the upland to a stream. Slopes: 0-4%.
Sinkhole	A topographic depression produced by subsidence of the land surface into a subterranean void. A surface drainage outlet is absent or if present, is at a higher elevation than the bottom of the depression. Slopes: 0-4%.

Aspect or direction of slope affects the growth and adaptability of many plant species. North and east-facing slopes are generally more moist and cool, and south and west-facing slopes are warm and dry. For example, shortleaf pine overcomes hardwood competition better on south slopes because it tolerates dry sites better than most hardwoods.

Four classes of aspects are recognized: north and east, south and west, neutral, and "all." 1/ North and east aspect is from 330 through 120, and south and west is from 120 through 330 degrees azimuth on side slopes greater than 8 percent. If slope is less than 8 percent, aspect is considered to be neutral. (Toe slopes may be as steep as 14 percent, but aspect is disregarded in classifying them; they comprise the "all" aspects class.)

Soils

Soils criteria are used to reflect the availability of soil moisture and plant nutrients, internal soil drainage or aeration, and the ease and depth of plant root development. These qualities appeared to most affect the establishment, growth and development of plant species on specific Ecological Landtypes. From a review of the soil characteristics, plant requirements, and growth rates of dominant plant species within the area,

1/ Adapted from Hartung and Gilbert in Gilbert (1971).

four soil characteristics were selected to reflect these qualities. They are soil depth, texture, drainage, and parent material. Using these characteristics as a guide the soil series occurring on the forest were combined into groups to form the soil criterion used in classification and delineation of Ecological Landtypes. The soil characteristics, classes and series groupings are given below.

Depth classes:

Deep. - 40 inches and more
Shallow. - 15-40 inches
Very shallow. - 0-15 inches

Texture classes: (Soil Survey Staff, 1975, p. 383.)

Fragmental. - Stones, cobbles, gravel, and very coarse sand particles; too little fine earth to fill interstices larger than 1 mm in diameter.

Loamy-skeletal. - Rock fragments make up 35 percent or more by volume; enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is loamy as defined for the loamy particle size class.

Sandy-skeletal. - Rock fragments 2 mm in diameter or larger make up 35 percent or more by volume; enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is sandy as defined for the sandy particle-size class.

Clayey-skeletal. - Rock fragments make up 35 percent or more by volume; enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is clayey as defined for the clayey particle-size class.

Sandy. - The texture of the fine earth is sand or loamy sand but not loamy very fine sand or very fine sand; rock fragments make up less than 35 percent by volume.

Loamy. - The texture of the fine earth is loamy very fine sand, very fine sand, or finer, but the amount of clay is less than 35 percent; rock fragments are less than 35 percent by volume.

Clayey. - The fine earth contains 35 percent or more clay by weight, and rock fragments are less than 35 percent by volume.

Drainage classes: (Soil Survey Staff, 1951, p. 169.)

Very poorly drained. - Water is removed from the soil so slowly that the water table remains at or on the surface the greater part of the time. Soils of this drainage class usually occupy level or depressed sites and are frequently ponded.

Poorly drained. - Water is removed so slowly that the soil remains wet for a large part of the time. The water table is commonly at or near the surface during a considerable part of the year. Poorly drained conditions are due to a high water table, to a slowly permeable layer within the profile, to seepage, or to some combination of these conditions.

Somewhat poorly drained. - Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. These soils commonly have a slowly permeable layer within the profile, a high water table, additions through seepage, or a combination of these conditions.

Moderately well drained. - Water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time. Moderately well drained soils commonly have a slowly permeable layer within or immediately beneath the solum, a relatively high water table, additions of water through seepage, or some combination of these conditions.

Well-drained. - Water is removed from the soil readily but not rapidly. Well-drained soils are commonly intermediate in texture, although soils of other textural classes may also be well drained.

Somewhat excessively drained. - Water is removed from the soil rapidly. Some of the soils are lithosolic. Many of them have little horizon differentiation and are sandy and very porous.

Excessively drained. - Water is removed from the soil very rapidly. Excessively drained soils are commonly Lithosols or lithosolic, and may be steep, very porous, or both. Shallow soils on slopes may be excessively drained.

Soil parent material classes:

Alluvium. - Soil materials that have been transported and laid down by flowing water.

Colluvium. - Soil materials that have been moved from the slope above and deposited at the base of the slope by gravity.

Limestone Residuum. - The unconsolidated residue from weathered cherty limestone in place containing partly weathered minerals and angular rock fragments from the consolidated rock. Included are some residues from interbedded cherty sandstones.

Felsitic Residuum. - The unconsolidated residue from weathered felsitic igneous rock in place containing partly weathered minerals and angular fragments from the consolidated rock. Includes residue from weathered granitic igneous rock.

Loess. - Material transported and deposited by wind and consisting of predominately silt-size particles with no rock fragments.

Glacial Till. - Unstratified glacial drift material deposited directly by ice and consisting of clay, sand, gravel, and boulders intermingled in any proportion. Rock fragments are often rounded and polished by abrasive action during transportation. Minerals are only slightly weathered.

Soil Groups:

Applying the soil depth, texture, drainage and parent material criteria led to the following groups of soils:

1. Deep loamy excessively drained soils formed in alluvium. Loamy and mixed alluvial lands, Wideman series

2. Deep loamy well drained soils formed in alluvium. Ashton, Secesh, Razort, Sharon, Huntington, Gladden, Elk series

3. Deep loamy moderately well drained soils formed in alluvium. Adler series

4. Deep loamy somewhat poorly drained soils formed in alluvium. Newark, Westerville, Hontas, Hartville series

5. Deep loamy poorly drained soils formed in alluvium. Calhoun series

6. Deep loamy-skeletal well to excessively drained soils formed in alluvium.
Midco, Elsah, Cedargap series

7. Deep loamy well and moderately well drained soils formed in colluvium. Claiborne, Viraton, Peridge, Crider, Mindale series

8. Deep loamy-skeletal and clayey moderately well drained soils with fragipans, formed in limestone residuum. Wilderness, Lebanon series

9. Deep loamy and clayey-skeletal well to somewhat excessively drained soils formed in limestone and sandstone residuum. Clarksville, Coulstone, Poynor, Ocie, Goss series

10. Deep loamy and clayey moderately well to well drained soils formed in limestone residuum. Captina, Viraton, Macedonia, Doniphan series

11. Moderately deep clayey well drained soils formed in limestone residuum. Bardley, Gatewood, Opequon series

12. Shallow loamy-skeletal excessively drained soils formed in limestone residuum. Gasconade, Gasconade-Rockland complex

13. Shallow loamy-skeletal excessively drained soils formed in sandstone residuum. Ramsey series

14. Moderately deep loamy-skeletal well drained soils formed in felsite and granite residuum. Irondale, Syenite series

15. Moderately deep loamy moderately well drained soils formed in felsite residuum capped with loess. Knobtop series

16. Deep loamy moderately well drained soils formed in loess over granite. Delassus series

17. Shallow loamy soils and felsite and granite bedrock outcrop.
Unnamed complex (Granite Glades)

18. Deep loamy moderately well drained soils formed in loess.
Loring series

19. Deep clayey moderately well drained soils formed in loess. Hatton, Gorin series

20. Deep loamy well drained soils formed in loess. Winfield series

21. Deep clayey somewhat poorly drained soils formed in loess. Mexico, Calwoods series

22. Deep loamy well drained soils formed in till. Lindley series

23. Deep clayey moderately well drained soils formed in till.
Keswick series

Vegetation

Knowledge of natural plant communities allows the manager to predict the potential of an Ecological Landtype. Vegetation was used to guide the previous soil groupings; and some ELT's can be differentiated only by reference to their vegetation (i.e., ELT's 4, 5, and 6; 21, 22, and 23; 26 and 27). Naturally, it is very difficult to use natural plant communities as criteria for ELT mapping, since very few unaltered sites are to be found. However, preliminary ELT mapping can be accomplished without reference to living elements of the ecosystem.

Forty-six natural plant communities are identified and used in defining Ecological Landtypes. By and large the names and descriptions of the communities are drawn from the "Terrestrial Natural System of Missouri" (Nelson, 1981). In a few cases the Missouri Natural Communities were subdivided into two or more communities to better reflect ranges of dominant species, or altered somewhat to better fit local conditions. One new community (dry bottomland forest) was identified and described.

Dominant communities are used as criteria; however, small areas of other communities may be present in some Ecological Landtypes. In a few cases several communities are used in defining an Ecological Landtype. They may be either a complex or one or the other within a given Landtype Association. In these instances specific complexes or communities are identified and noted in the Ecological Landtype description of the unit inventory report.

In the following natural plant community definitions dominant plants include those plants, regardless of structural position, which are often dominant in the community. Characteristic plants are other species often found in a given community.

1. Mesic bottomland forest

   Dominant plants - sugar maple, bitternut hickory, hackberry, white oak

   Characteristic plants - blackgum, hazelnut, black walnut, green ash, honeylocust, Ohio buckeye, elderberry, spice bush, yellow ironweed, wild ginger, joe-pye-weed, avens, waterleaf, Virginia bluebell, pale violet, clearweed, perennial phlox, white dogtooth violet, wood nettle, harbinger-of-spring, false rue anemone, bladder fern, grape fern

2. Mesic bottomland forest

   Dominant plants - sweetgum, American elm, sugar maple, shellbark hickory, giant cane, Drummond's red maple

   Characteristic plants - southern buckthorn, red buckeye, phlox sp., mistletoe, phacelia

3. Mesic bottomland forest

   Dominant plants - bur oak, pin oak, American elm, shellbark hickory

   Characteristic plants - downy hawthorn, wild cucumber vine, snowy campion, spiderwort (T. subaspera), small bellwort, Solomon's seal, anemone

4. Wet-mesic bottomland forest

   Dominant plants - silver maple, sycamore

   Characteristic plants - green ash, river birch, hackberry, cottonwood, American elm, bur oak, poison ivy, wood nettle, giant cane, spicebush, bladdernut, Ohio buckeye, redbud, phlox, beggarticks, spikegrass

5. Wet-mesic bottomland forest

   Dominant plants - bur oak, swamp chestnut oak, silver maple, American elm, poison ivy, wood nettle

   Characteristic plants - willow oak, overcup oak, Nutall's oak, stiff dogwood, snowbell, greenbrier, nodding pogonia orchid, lizards tail

   Restricted plants - 6 species without common names: Spilanthes americana, Eupatorium incarnatum, Penstemon alluviorum, Lindera melissaefolium, Crataegus marshallii, Ophioglossum vulgatum pseudopoda

6. Wet-mesic bottomland forest

   Dominant plants - bur oak, swamp white oak, silver maple, American elm, poison ivy, wood nettle

7. Wet-mesic bottomland forest

   Dominant plants - silver maple, sycamore

   Characteristic plants - river birch, elm, hackberry, boxelder, cottonwood, black walnut, elderberry, wild grape, greenbrier, nettle, jewelweed, spikegrass, blackeyed susan, cupplant, fall bellflower, sunflower, sedges

8. Dry-mesic bottomland forest

   Dominant plants - white oak, shagbark hickory, shumard oak, blackgum, black cherry

Characteristic plants - sugar maple, Ohio buckeye, Ozark witch-hazel, hazelnut, figwort, elephant's-foot, tall bellflower, lyre-leaved sage (cancer weed), yellow giant hyssop, wood spurge, wild senna, nodding chickweed, spike grass, diarrhena grass, sedge

9. Dry bottomland forest

Dominant plants - elm, chinkapin oak, hickory, white oak, hackberry, blackgum

Characteristic plants - flowering dogwood, blackhaw, Carolina buckthorn, mulberry, hazelnut, hawthorn, bluegrass, muhly grass, avens, bedstraw, blackeyed susan, horse gentian, violet, coralberry

10. Gravel wash

Dominant plants - (None listed.)

Characteristic plants - Ozark witch-hazel, buttonbush, swamp dogwood, ninebark, water willow, Ward's willow, black willow, sand grape, hop tree, pipe vine, blue star, cardinal flower, wild ageratum, umbrella grass, ragweed, dayflower, rough buttonweed, cocklebur, ironweed, panic grasses, knotweeds.

11. Mesic forest

Dominant plants - northern red oak, sugar maple, white oak

Characteristic plants - black maple, beech, bitternut hickory, Kentucky coffeetree, Ohio buckeye, black walnut, American elm, pawpaw, wood nettle, enchanter's nightshade, squirrel corn, bladder fern, maidenhair fern, sweet cicely, smooth yellow violet.

12. Mesic forest

Dominant plants - northern red oak, sugar maple, white oak, basswood

Characteristic plants - black maple, bitternut hickory, Kentucky coffeetree, Ohio buckeye, black walnut, American elm, pawpaw, wood nettle, enchanter's nightshade, squirrel corn, bladder fern, maiden-hair fern, sweet cicely, smooth yellow violet

13. Dry-mesic forest

Dominant plants - white oak, northern red oak, shagbark hickory, sugar maple

Characteristic plants - eastern hophornbeam, Virginia creeper, tick trefoil, bedstraw, rattlesnake fern, sedge, grass

14. Dry forest

Dominant plants - white oak, black oak, chinkapin oak, rough-leaved dogwood, prickly ash, pennyroyal

Characteristic plants - muhly grass, poverty oat grass, pussytoes (2 species), prairie mimosa, Dicranum scoparium, sedges

15. Dry-mesic chert forest

Dominant plants - white oak, northern red oak, black oak, blackgum, flowering dogwood, Virginia creeper

Characteristic plants - mockernut hickory, red maple, eastern hophornbeam, black cohosh, yellow lady slipper, twayblade orchid, starry campion, milk pea, tick trefoil (D. nudiflorum, D. glutinosum)

16. Dry chert forest

Dominant plants - black oak, white oak, post oak, flowering dogwood, lowbush blueberry

Characteristic plants - black hickory, pignut hickory, sassafras, goat's rue, long-bracted wild indigo, dittany, poverty oat grass, bush clover, tick trefoil, gerardia, bedstraw, bracken fern, stiff-leaf aster, horse mint, wood rush, sedges, panic grasses, mosses

17. Dry chert forest

Dominant plants - black oak, scarlet oak, flowering dogwood, lowbush blueberry

Characteristic plants - white oak, black hickory, pignut hickory, sassafras, goat's rue, long-bracted wild indigo, dittany, poverty oat grass, bush clover, tick trefoil, gerardia, bedstraw, stiff-leaf aster, horsemint, wood rush, sedges, panic grasses, mosses

18. Dry chert forest

Dominant plants - white oak, black oak, shortleaf pine, lowbush blueberry, highbush blueberry

Characteristic plants - black hickory, pignut hickory, sassafras, goat's rue, long-bracted wild indigo, dittany, poverty oat grass, bush clover, tick trefoil, gerardia, bedstraw, bracken fern, stiff-leaf aster, horsemint, wood rush, sedges, panic grasses, mosses, nemastylis, sand phlox

Restricted plants - Ozark chinkapin, Ozark wake-robin

19. Dry chert forest

Dominant plants - white oak, black oak, scarlet oak, shortleaf pine, flowering dogwood, lowbush blueberry

Characteristic plants - black hickory, pignut hickory, sassafras, goat's rue, long-bracted wild indigo, dittany, poverty oat grass, bush clover, tick trefoil, gerardia, bedstraw, bracken fern, stiff-leaf aster, horsemint, wood rush, sedges, panic grasses, mosses

Restricted plants - wild crocus (*T. longipes*), cinquefoil (*P. canadensis*)

20. Dry chert forest

Dominant plants - white oak, black oak, post oak, shortleaf pine, flowering dogwood, lowbush blueberry

Characteristic plants - black hickory, pignut hickory, sassafras, goat's rue, long-bracted wild indigo, dittany, poverty oat grass, bush clover, tick trefoil, gerardia, bedstraw, bracken fern, stiff-leaf aster, horsemint, wood rush, sedges, panic grasses, mosses

Restricted plants - wild crocus (*T. longipes*), cinquefoil (*P. canadensis*)

21. Dry chert forest

Dominant plants - white oak, black oak, shortleaf pine, flowering dogwood, lowbush blueberry

Characteristic plants - black hickory, pignut hickory, sassafras, goat's rue, long-bracted wild indigo, dittany, poverty oat grass, bush clover, tick trefoil, gerardia, bedstraw, bracken fern, stiff-leaf aster, horsemint, wood rush, sedges, panic grasses, mosses, nemastylis, sand phlox

Restricted plants - Ozark chinkapin, Ozark wake-robin

22. Xeric chert forest

Dominant plants - post oak, black oak, highbush blueberry, goat's rue

Characteristic plants - six-weeks fescue, poverty oat grass, panic grass, gayfeather, white oak, prairie acacia

23. Xeric chert forest

Dominant plants - post oak, black oak, shortleaf pine, highbush blueberry, goat's rue

Characteristic plants - six-weeks fescue, poverty oat grass, panic grass, gayfeather, white oak, prairie acacia

24. Mesic savanna

Dominant plants - bur oak, white oak, big bluestem, Indian grass

25. Hardpan prairie

Dominant plants - big bluestem, Indian grass, switch grass

Characteristic plants - prairie mimosa, bedstraw, water hemlock, sedges, redtop, milkweed, goldenrod, aster, wild hyacinth

26. Glade savanna

Dominant plants - post oak, white oak, black oak, little bluestem, eastern redcedar

Characteristic plants - poverty oat grass, sideoats grama, gayfeather, Ashe juniper

27. Dry savanna

Dominant plants - post oak, blackjack oak, little bluestem

Characteristic plants - goat's rue, poverty oat grass, long-bracted wild indigo, gayfeather

28. Dry-mesic limestone forest

Dominant plants - white oak, sugar maple, northern red oak, flowering dogwood

Characteristic plants - shagbark hickory, American elm, eastern hophornbeam, Virginia creeper, bladder fern, tick trefoil, blue wood aster

29. Dry limestone forest

Dominant plants - white oak, eastern redcedar, dwarf chinkapin oak, sugar maple, flowering dogwood, fragrant sumac

Characteristic plants - Carolina buckthorn, black cohosh, rock cress, Seneca snakeroot, green violet, bedstraw, crested coralroot, tall anemone, smoke tree, possumhaw, fringe tree, beauty berry, Arkansas penstemon, tragia

Restricted plants - a hawthorn species, Crataegus padifolia

30. Dry limestone forest

Dominant plants - white oak, eastern redcedar, dwarf chinkapin oak, sugar maple, flowering dogwood, fragrant sumac

Characteristic plants - eastern redcedar, Carolina buckthorn, black cohosh, rock cress, Seneca snakeroot, green violet, bedstraw, crested coralroot, tall anemone

Restricted plants - tall larkspur

31. Dry limestone forest

Dominant plants - white oak, black oak, post oak, rough-leaved dogwood, prickly ash, pennyroyal

Characteristic plants - muhly grass, poverty oat grass, pussytoes (2 species), prairie mimosa, Dicranum scoparium, sedge

32. Xeric limestone forest

Dominant plants - eastern redcedar, dwarf chinkapin oak, fragrant sumac, greenbrier

Characteristic plants - white ash, blue ash, persimmon, rusty blackhaw, adder's-tongue fern, fringe tree, supplejack, smoke tree

33. Xeric limestone forest

Dominant plants - eastern redcedar, dwarf chinkapin oak, fragrant sumac, greenbrier

Characteristic plants - white ash, blue ash, persimmon, rusty blackhaw, adder's tongue fern

34. Dolomite glade

Dominant plants - little bluestem, sideoats grama

Characteristic plants - blackeyed susan, helioptrope, sandwort, silky aster, blue hearts, Indian paintbrush, sugarberry, bastard toadflax, shooting star, pale-purple coneflower, houstonia, gayfeather, puccoon, Missouri evening primrose, prairie clover, post oak, Carolina buckthorn, fragrant sumac, calamint, prairie dock, birds-foot violet, yellow stargrass, bald grass, sedges

35. Limestone glade

Dominant plants - little bluestem, sideoats grama, bald grass, Indian grass

Characteristic plants - blackeyed susan, helioptrope, sandwort, silky aster, blue hearts, Indian paintbrush, sugarberry, bastard toadflax, shooting star, pale-purple coneflower, houstonia, gayfeather, puccoon, Missouri evening primrose, prairie clover, post oak, Carolina buckthorn, fragrant sumac, calamint, prairie dock, birds-foot violet, yellow stargrass, bald grass, sedges

Restricted plants - blue false indigo, nut grass, yucca, umbrella plant, prairie acacia, phyllanthus, smoke tree, stenosiphon, palafoxia, centaury, skullcap, beard-tongue (P. cobaea purpureus), thelesperma, Ashe juniper, poison oak

36. Igneous glade

Dominant plants - Indian grass, Crotonopsis elliptica, ragweed, highbush huckleberry, post oak, winged elm, lichen (Cladina spp.)

Characteristic plants - hairy lip-fern, annual bent-grass, panic grasses, little bluestem, blue curls, poverty grass (Aristida), rough buttonweed, Seneca snakeroot, pine-weed, sedges, knotweed (P. tenue), sundrops (Oenothera linifolia)

37. Dry-mesic igneous forest

Dominant plants - white oak, northern red oak, scarlet oak

Characteristic plants - blackgum, mockernut hickory, red maple, Hercules' club, poison ivy, bellwort, knotweed, aster (A. turbinellus), tick trefoil (D. glutinosum)

Restricted plants - eastern witch-hazel, whitlow grass

38. Dry igneous forest

Dominant plants - white oak, scarlet oak, black oak, highbush huckleberry, fragrant sumac

Characteristic plants - shortleaf pine, black hickory, white ash, serviceberry, arrow-leaved violet, angelica, sand phlox, gattinger hawthorn, forked chickweed

39. Xeric igneous forest

Dominant - post oak, winged elm, winged sumac, little bluestem

Characteristic plants - poverty grass (Aristida dichotoma), highbush huckleberry, gayfeather

40. Dry-mesic sand forest

Dominant plants - white oak, northern red oak, southern red oak, black oak

Characteristic plants - flowering dogwood, Virginia creeper, poison ivy, muhly grass

41. Dry sand forest

Dominant plants - white oak, scarlet oak, black oak, shortleaf pine, lowbush blueberry, highbush blueberry

Characteristic plants - serviceberry, bracken fern, middle-sized blueberry, narrow-leaf aster

Restricted plants - wild pink (Silene caroliniana), central Ozarks; tick trefoil (D. humifusum), Shannon and Pulaski Counties; evening primrose (Oenothera fruiticosa), Shannon and Oregon Counties; stagger bush (Lyonia mariana), Dent County

42. Dry sand forest

Dominant plants - white oak, black oak, lowbush blueberry, highbush blueberry

Characteristic plants - serviceberry, bracken fern, middle-sized blueberry, narrow-leaf aster

43. Xeric sand forest

Dominant plants - post oak, blackjack oak, shortleaf pine, highbush blueberry, little bluestem

Characteristic plants - moss (Polytrichum juniperum), Hedwigia sp.

44. Xeric sand forest

Dominant plants - post oak, blackjack oak, highbush blueberry, little bluestem

Characteristic plants - moss (Polytrichum juniperum), Hedwigia sp.

45. Calcareous wet forest

Dominant plants - red maple, American elm, green ash, moss

Characteristic plants - honeylocust, hazel alder, wood reed grass, wild sweet william, southern blue flag, panic grass, sedges, closed gentian, rough-leaf goldenrod, bedstraw, knotweed, sensitive fern, purple fringeless orchid, swamp wood betony, water pimpernel

Restricted plants - bulrush (Scirpus polyphyllus)

46. Acid seep forest

Dominant plants - water tupelo, pin oak

Characteristic plants - spicebush, hazel alder, buttonbush, royal fern, cinnamon fern, lance-leaf violet, hypericum, sphagnum, moss

NAMES AND DEFINITIONS

Numerical names are used for Ecological Landtypes. Names 1 through 50 are used for the Ozark Province and 51 through 99 for the Central Lowland Province. Names are assigned in numerical order as new Ecological Landtypes are identified.

Landform (including slope and aspect), soil series, and natural vegetation community used to define Ecological Landtypes are given below.

Definitions

Name	Land Form	Aspect	Percent Slope	Soil Series	Vegetation Community [1/]
1	Low Flood	Neutral	0-4	Loamy Alluvial Mixed Alluvial Wideman	Wet mesic bottomland forest(4) Gravel wash(10)
2	Flood Plain, Low Terrace	Neutral	0-4	Newark Westerville Hontas Hartville	Calcareous wet forest (45)
3	High Flood Plain, Low Terrace	Neutral	0-4	Ashton Secesh Huntington Gladden Razort Elk	Mesic bottomland forest(1)
4	Upland Waterway	Neutral	0-4	Midco Elsah Cedargap	Gravel wash(10)
5	Upland Waterway	Neutral	0-4	Midco Elsah Cedargap	Dry bottomland forest(9)
6	Upland Waterway	Neutral	0-4	Midco Elsah Cedargap	Dry-mesic bottomland forest (8)
7	Toe Slope	All	0-14	Claiborne Peridge Mindale Viraton Crider	Mesic forest(11)
8	Ridge	Neutral	0-8	Wilderness Nixa	Xeric chert forest (22) Dry savanna(27)
9	Ridge	Neutral	0-8	Clarksville Coulstone Poynor Doniphan	Dry chert forest (16, 17)
10	Ridge	Neutral	0-8	Wilderness Nixa	Xeric chert forest (23)
11	Ridge	Neutral	0-8	Clarksville Coulstone Poynor Doniphan	Dry chert forest (19, 20)

1/ Both community names and definition numbers are given.

Definitions

Name	Land Form	Aspect	Percent Slope	Soil Series	Vegetation Community
12	Flat	Neutral	0-8	Lebanon Wilderness Nixa	Xeric chert forest (22) Dry savanna(27)
13	Flat	Neutral	0-8	Captina Macedonia Doniphan Viraton	Dry chert forest (16, 17)
14	Flat	Neutral	0-8	Lebanon Wilderness Nixa Ocie	Xeric chert forest (23)
15	Flat	Neutral	0-8	Captina Macedonia Doniphan Viraton	Dry chert forest (19, 20, 21)
16	Side Slope	South and West	8-99	Clarksville Coulstone Poynor Doniphan Ocie	Dry chert forest (16, 17)
17	Side Slope	South and West	8-99	Clarksville Coulstone Poynor Doniphan Ocie	Dry chert forest (19, 20)
18	Side Slope	North and East	8-99	Clarksville Coulstone Poynor Doniphan Ocie	Dry-mesic chert forest (1) Dry-mesic sand forest (15, 40)
19	Side Slope	South and West	8-99	Bardley Opequon Gatewood	Glade savanna(26)
20	Side Slope	North and East	8-99	Bardley Opequon Gatewood	Dry mesic limestone forest(28)
21	Side Slope	All	5-99	Gasconade Rockland	Dolomite glade(34) Limestone glade(35)
22	Side Slope	All	5-99	Gasconade Rockland	Xeric limestone forest(32)
23	Side Slope	All	5-99	Gasconade Rockland	Dry limestone forest (30)
24	Side Slope	South and West	8-99	Irondale Syenite	Dry igneous forest (38)
25	Side Slope	North and East	8-99	Irondale Syenite	Dry-mesic igneous forest(37)

Definitions

Name	Land Form	Aspect	Percent Slope	Soil Series	Vegetation Community
30	Ridge	Neutral	0-8	Irondale	Dry igneous forest (38)
26	Side Slope	All	5-99	Unnamed (Granite Glades)	Igneous glade(36)
27	Side Slope	All	5-99	Unnamed (Granite Glades)	Xeric igneous forest (39)
28	Flat	Neutral	0-8	Knobtop	Dry igneous forest(38)
29	Flat	Neutral	0-14	Loring	Dry chert forest(17)
31	Side Slope	South and West	8-99	Ramsey	Xeric sand forest(43)
32	Side Slope	South and West	8-99	Ramsey	Xeric sand forest(44)
33	Side Slope	North and East	8-99	Ramsey	Dry sand forest(42)
34	Flat	Neutral	0-8	Delassus	Dry igneous forest(38)
35	Sinkhole	Neutral	0-4	Ashton	Mesic forest(12)
36	Sinkhole	Neutral	0-2	Newark	Acid seep forest(46)
37	Bench or Terrace	Neutral	0-8	Ocie	Dry chert forest(18)
38	Low Flood Plain	Neutral	0-2	Calhoun	Wet-mesic bottomland forest (38)
39	Low Flood Plain	Neutral	0-2	Adler	Mesic bottomland forest(2)
51	Side Slope	All	8-99	Lindley	Dry-mesic forest(13)
52	Side Slope	North and East	8-99	Goss	Dry-mesic limestone forest(28)
53	Side Slope	South and West	8-99	Goss	Dry limestone forest (31)

Definitions

Name	Land Form	Aspect	Percent Slope	Soil Series	Vegetation Community
54	Ridge	Neutral	0-8	Hatton Gorin	Dry forest(14)
55	Side Slope	All	5-99	Keswick	Dry-mesic forest(13)
56	Upland Waterway	Neutral	0-4	Midco	Dry bottomland forest(9)
57	Side Slope	All	5-99	Gasconade Rockland Complex	Xeric limestone forest(33)
58	Toe Slope	All	0-14	Crider	Mesic forest(12)
59	Upland Waterway	Neutral	0-2	Sharon	Mesic bottomland forest(3)
60	Flat	Neutral	0-5	Mexico Calwoods	Mesic savanna(24) Hardpan prairie(25)
61	Upland Waterway	Neutral	0-2	Westerville	Wet-mesic bottomland forest(6)
62	Flood Plain	Neutral	0-2	Sharon	Wet-mesic bottomland forest(7)
63	Ridge	Neutral	0-8	Winfield	Dry-mesic forest(13)
64	Side Slope	All	8-99	Winfield	Dry-mesic forest(13)

Figure 5. Hierarchical Placement of Upper and Immediate Levels.

Subregion	Southern Forest Subregion				
Provinces		Ozark Plateau Province			Central Lowlands Province
Sections	St. Francois Mountains Section	Salem Plateau Section			Dissected Till Plains Section
Subsections	St. Francois Mountains Subsection	Upper Ozarks Subsection	Lower Ozarks Subsection	White River Subsection	Glaciated Plains Subsection
Landtype Associations Ecological Landtypes	Oak-Pine Mountains(F) 1,3-7,11, 15,17,18 21-28,30	Oak-Pine Hills(S) 1-7,11, 14&10,15 17-23,31,33	Oak-Pine Breaks(S) 1-7,11, 14&10,15,17-20,22,23	Oak-Pine Breaks(L) 1,3-7,11, 14&10,15 17-23,37	Oak-Hickory Hills(T) 51-64
Landtype Association Ecological Landtypes	Oak-Pine Breaks(F) 1,3-7,11, 14&10,15 17-28,30	Oak-Pine Hills(L) 1,3-7,11, 14&10,15 17-23	Oak-Pine Hills(S) 1-7,11, 14&10,15,17-20,22,23	Oak-Hickory Breaks(L) 1,3-7,9, 12&8,13,16 18-23,37	Oak-Bluestem Plains(T) 51-56, 58-62
Landtype Associations Ecological Landtypes	Oak-Pine Hills(F) 1-7,11,14&10 15,17,18, 21-28	Oak-Pine Plains(S) 1,3-7,11, 14&10,17,18,	Oak-Pine Hills(L) 1,3-7,11 14&10,15, 17-19,22,23	Cedar Glade Breaks(L) 1,3-7,9, 12&8,13,16, 18-23,37	
Landtype Associations Ecological Landtypes	Oak-Pine Plains(G) 1,3-7,15, 24,25,28,34	Oak-Hickory Hills(L) 1-7,9,12&8, 13,16,18-23, 32,33	Oak-Pine Plains(S) 5,11,14&10,15, 17,18	Oak-Hickory Hills(L) 1,3-7,9, 12&8,13,16, 18-23,37	
Landtype Associations Ecological Landtypes	Oak-Pine Breaks(L) 1,3-7,11 14&10,15 17,18,22,23	Oak-Hickory Plains(L) 1-7,9,12&8, 13,16,18,19	Oak-Pine Plains(L) 1,3-7,11,14&10, 15,17,18	Cedar Glade Hills(L) 1,3-7,9, 12&8,13,16, 18-23,37	
Landtype Associations Ecological Landtypes	Oak-Pine Hills(L) 1,3-7,11, 14,10,15,17,18		Oak-Hickory Hills (L) 1,3-7,9,12&8, 13,16,18-20,22		
Landtype Associations Ecological Landtypes	Oak-Pine Plains(L) 1,3-7,11, 14&10,17,18		Oak-Hickory Plains(L) 1,3-7,9,12&8, 13,16,18,22,23		
Landtype Associations Ecological Landtypes			Oak-Hickory Hills(Lo) 1,3-7,9,12&8,13, 16,18,29,38,39		

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

ST. FRANCOIS MOUNTAINS SUBSECTION

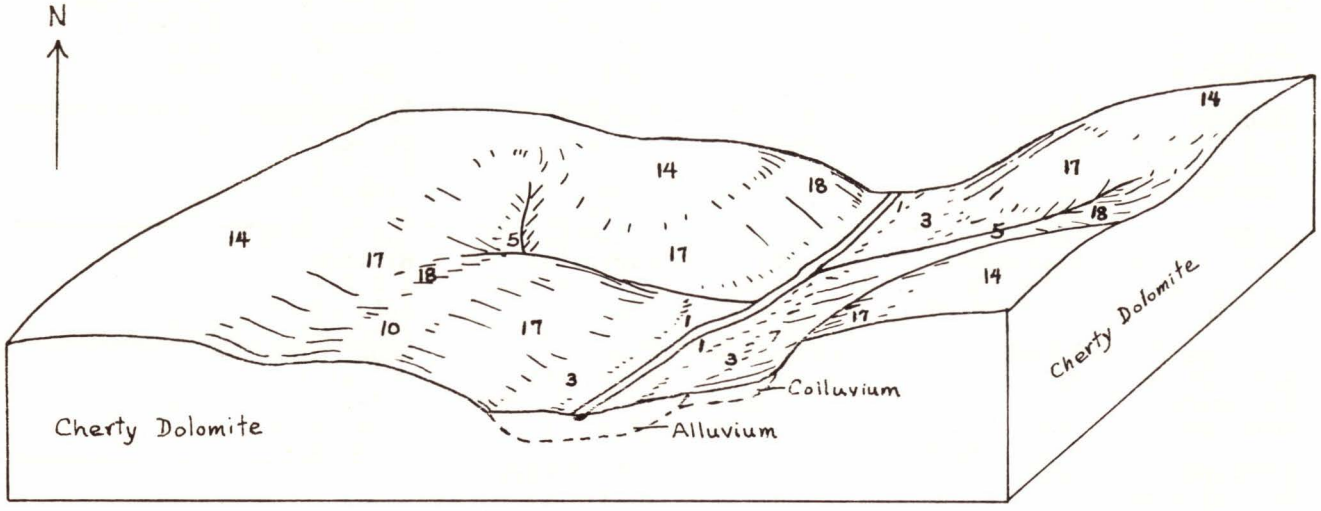


Figure 6. Oak-Pine Plains (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14, 10 - Ridges/deep clayey fragipan soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

ST. FRANCOIS MOUNTAINS SUBSECTION

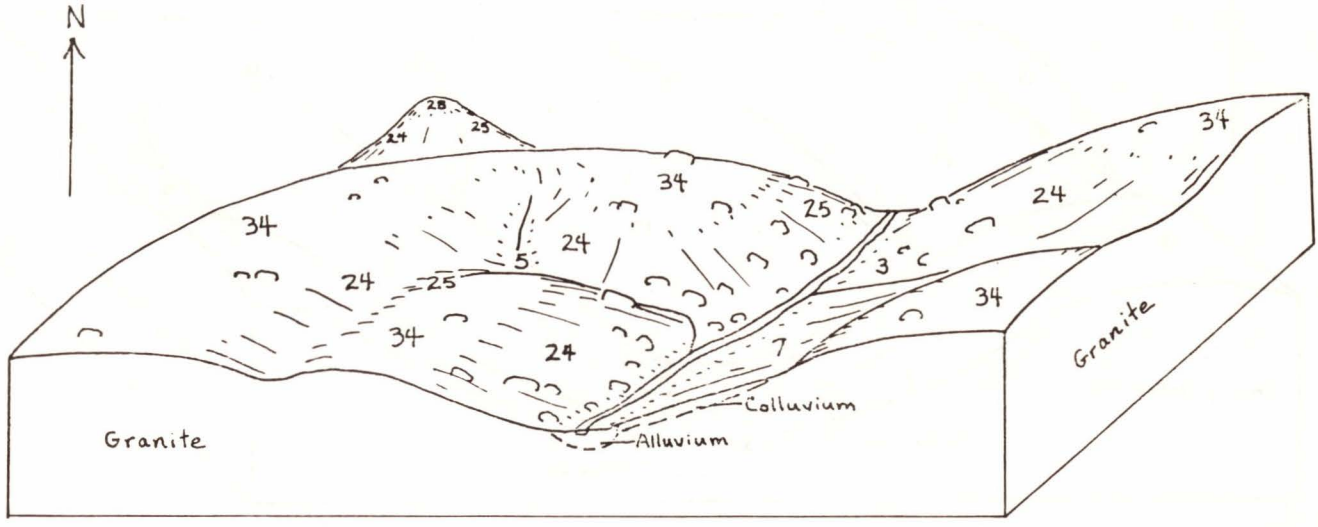


Figure 7. Oak-Pine Plains (Granite) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
15 - Broad ridges/deep loamy soils (not shown).
24 - Side slopes, south and west aspect/moderately deep stony soils.
25 - Side slopes, north and east aspect/moderately deep stony soils.
28 - Flats/moderately deep loamy soils.
34 - Flats/deep loamy soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

ST. FRANCOIS MOUNTAINS SUBSECTION

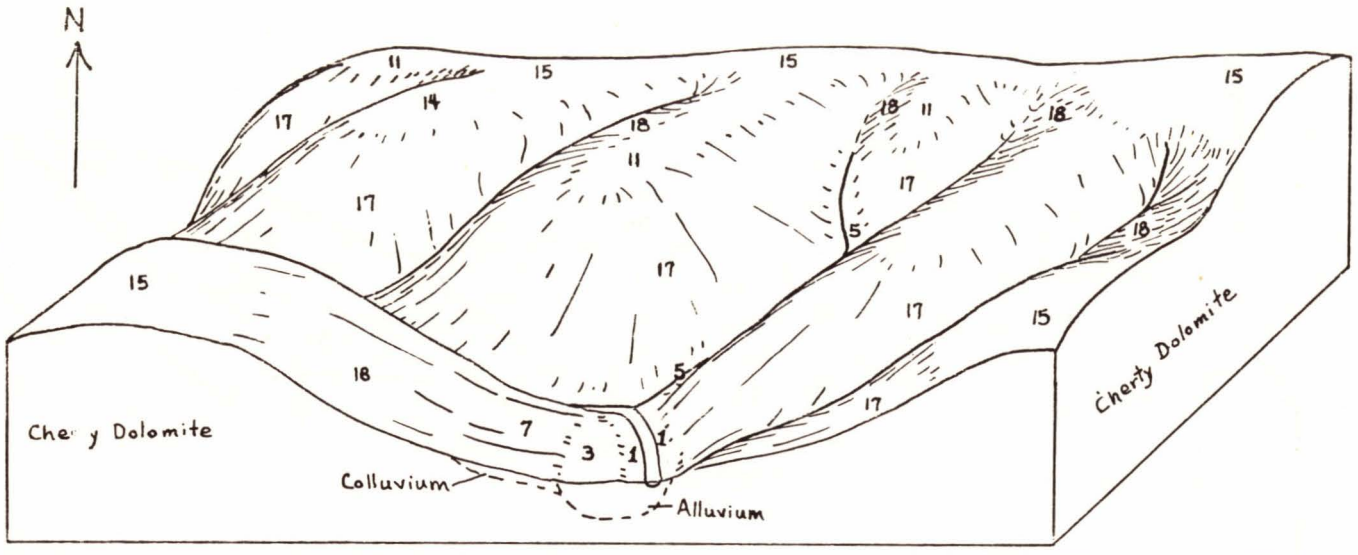


Figure 8. Oak-Pine Hills (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14, 10 - Ridges/deep cherty fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

ST. FRANCOIS MOUNTAINS SUBSECTION

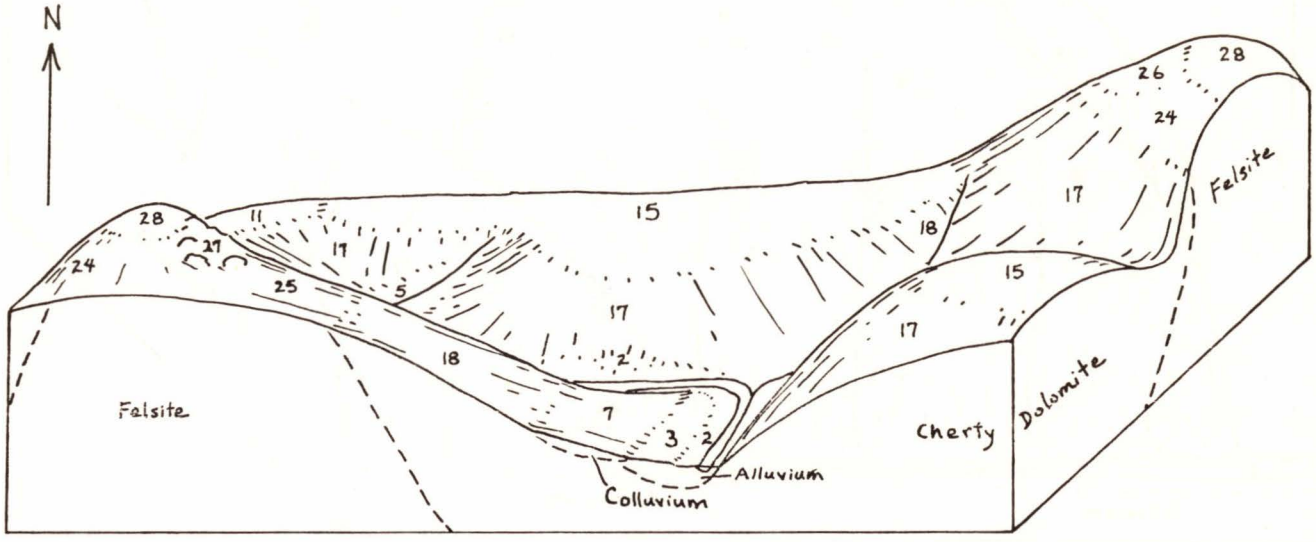


Figure 9. Oak-Pine Hills (Felsite) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
2 - High flood plains and low terraces/poorly drained soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14, 10 - Ridges/deep fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep cherty soils.
18 - Side slopes, north and east aspect/deep cherty soils.
21, 22, 23 - Side slopes/shallow soils - limestone outcrops.
24 - Side slopes, south and west aspect/moderately deep stony soils.
26 - Side slopes, south and west aspect/shallow soils - igneous rock outcrops.
27 - Side slopes, north and east aspect/shallow soils - igneous rock outcrops.
28 - Flats/moderately deep loamy soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

ST. FRANCOIS MOUNTAINS SUBSECTION

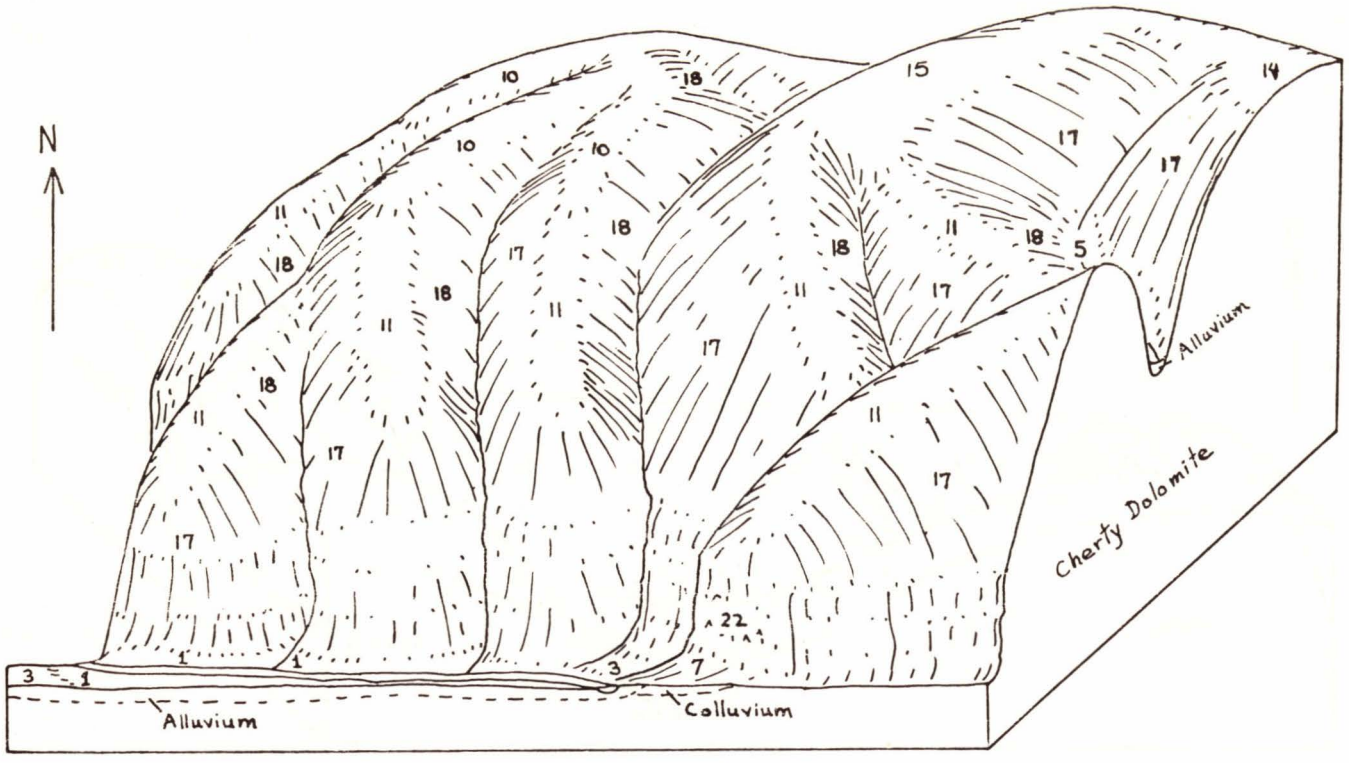


Figure 10. Oak-Pine Breaks (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6, - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14, 10 - Ridges/deep cherty fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
22, 23 - Side slopes/very shallow soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

ST. FRANCOIS MOUNTAINS SUBSECTION

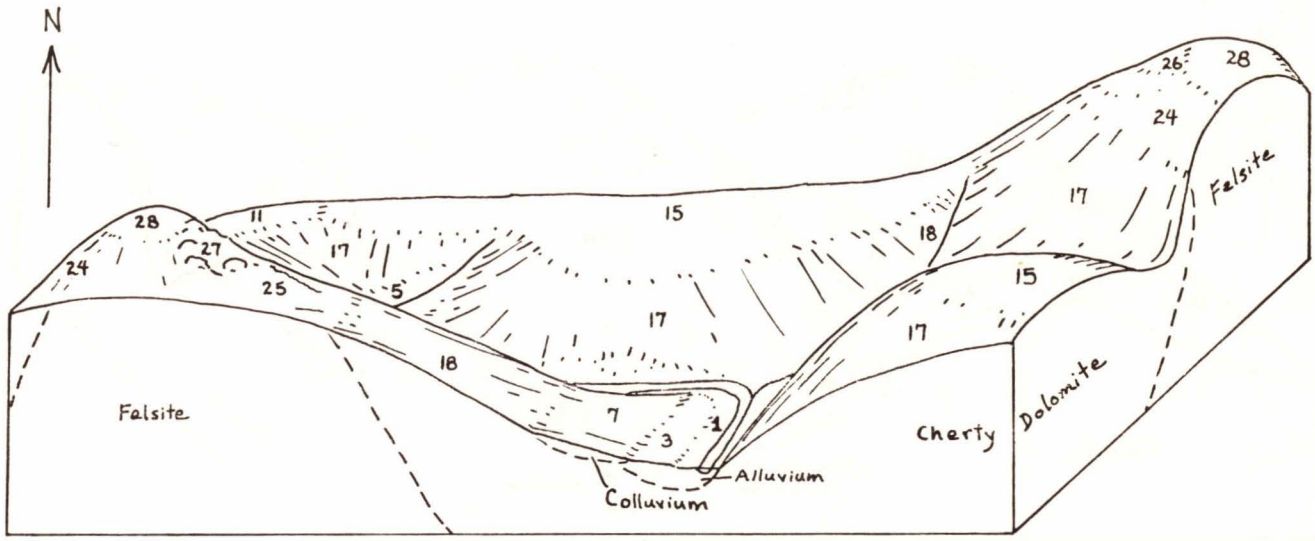


Figure 11. Oak-Pine Breaks (Felsite) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14, 10 - Ridges/deep loamy and clayey soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
22, 23 - Side slopes/very shallow soils.
24 - Side slopes, south and west aspect/deep soils.
25 - Side slopes, north and east aspect/deep soils.
26, 27 - Side slopes/very shallow soils with rock outcrops.
28 - Flats/moderately deep soils.
30 - Ridges/deep soils (not shown).

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

ST. FRANCOIS MOUNTAINS SUBSECTION

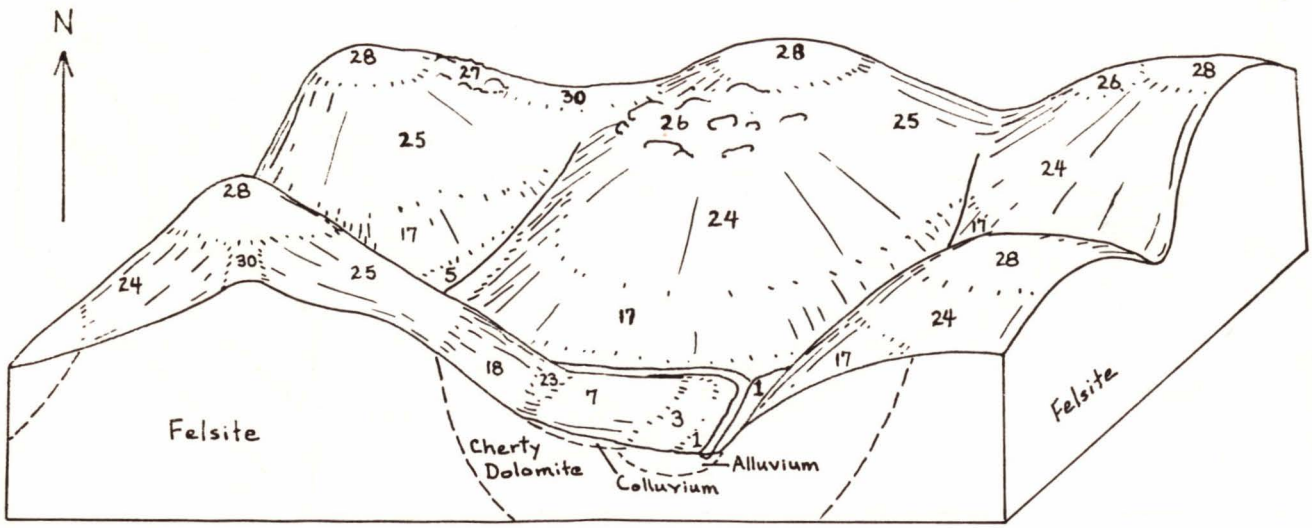


Figure 12. Oak-Pine Mountains (Felsite) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep cherty soils.
18 - Side slopes, north and east aspect/deep cherty soils.
21, 22, 23 - Side slopes/shallow soils - limestone outcrops.
24 - Side slopes, south and west aspect/moderately deep stony soils.
25 - Side slopes, north and east aspect/moderately deep stony soils.
26 - Side slopes, south and east aspect/shallow soils - igneous rock outcrops.
27 - Side slopes, north and east aspect/shallow soils - igneous rock outcrops.
28 - Flats/moderately deep loamy soils.
30 - Ridges/moderately deep stony soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

UPPER OZARK SUBSECTION

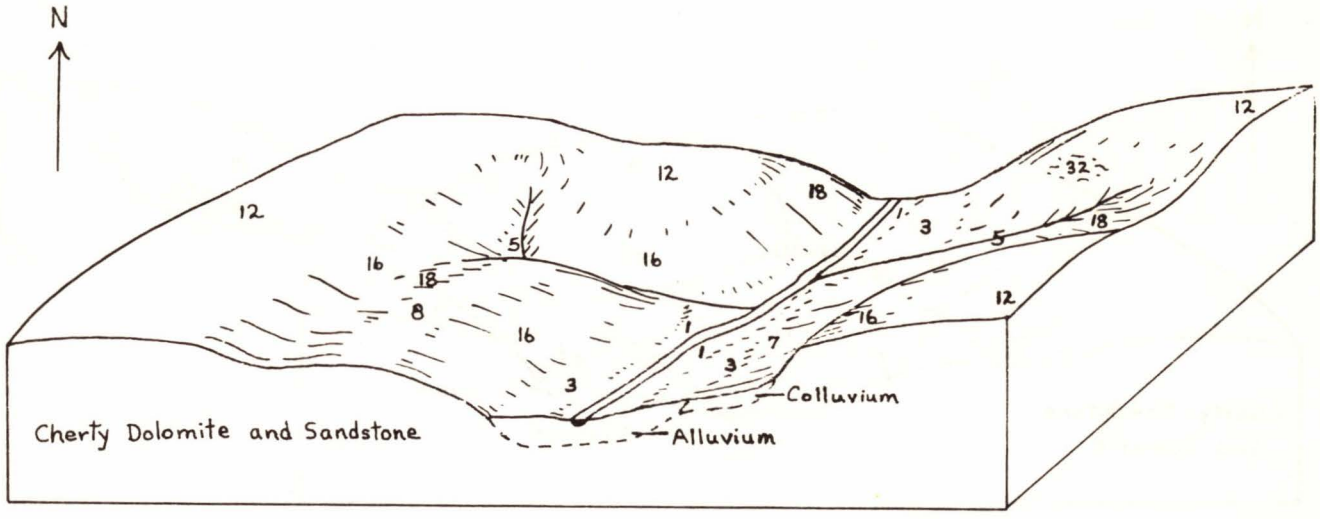


Figure 13. Oak-Hickory Plains (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
2 - High flood plains and low terraces/poorly drained soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
9 - Narrow ridges/deep cherty soils.
12, 8 - Ridges/deep fragipan soils.
13 - Broad ridges/deep loamy and clayey soils.
16 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/deep soils.
20 - Side slopes, north and east aspect/shallow soils.
21, 22, 23 - Side slopes/very shallow limestone soils.
32 - Side slopes, south and west aspect/very shallow sandstone soils.
33 - Side slopes, north and east aspect/very shallow sandstone soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

UPPER OZARK SUBSECTION

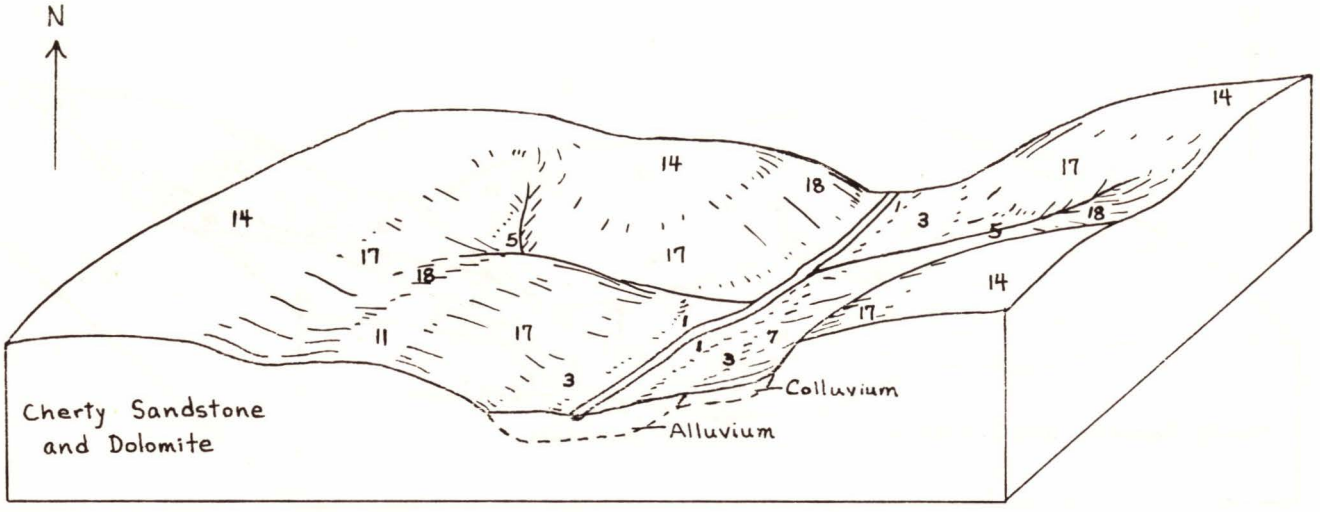


Figure 14. Oak-Pine Plains (Sandstone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14, 10 - Ridges/deep cherty fragipan soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

UPPER OZARK SUBSECTION

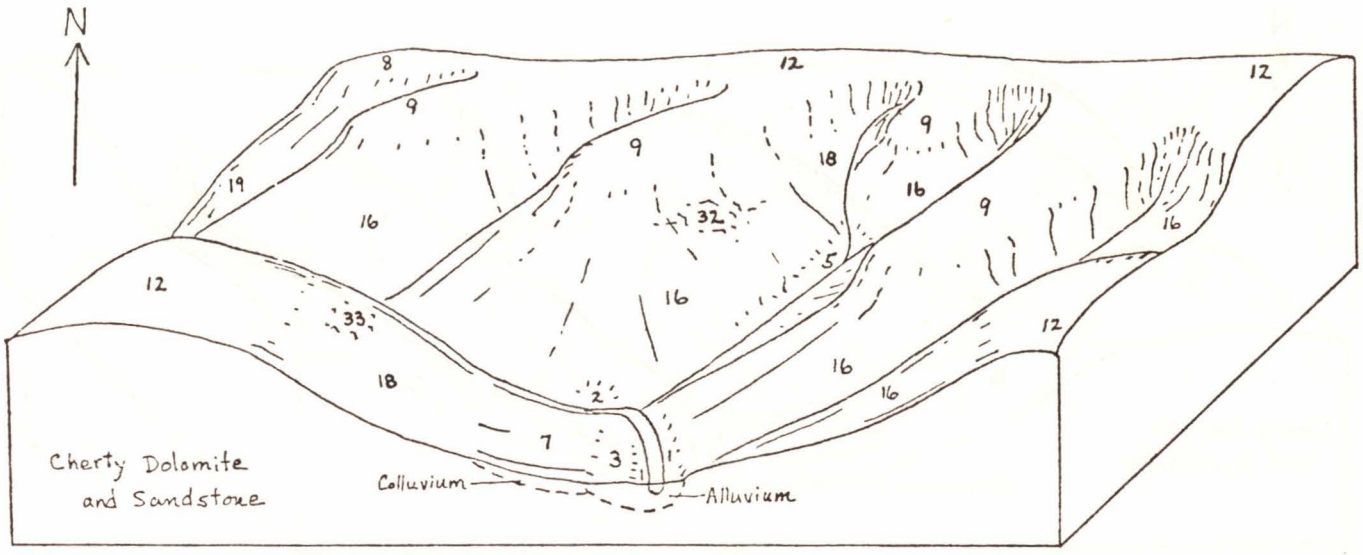


Figure 15. Oak-Hickory Hills (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
2 - High flood plains and low terraces/poorly drained soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
9 - Narrow ridges/deep cherty soils.
12, 8 - Ridges/deep fragipan soils.
13 - Broad ridges/deep loamy and clayey soils.
16 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
21, 22, 23 - Side slopes/very shallow limestone soils.
32 - Side slopes, south and west aspect/very shallow sandstone soils.
33 - Side slopes, north and east aspect/very shallow sandstone soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

UPPER OZARK SUBSECTION

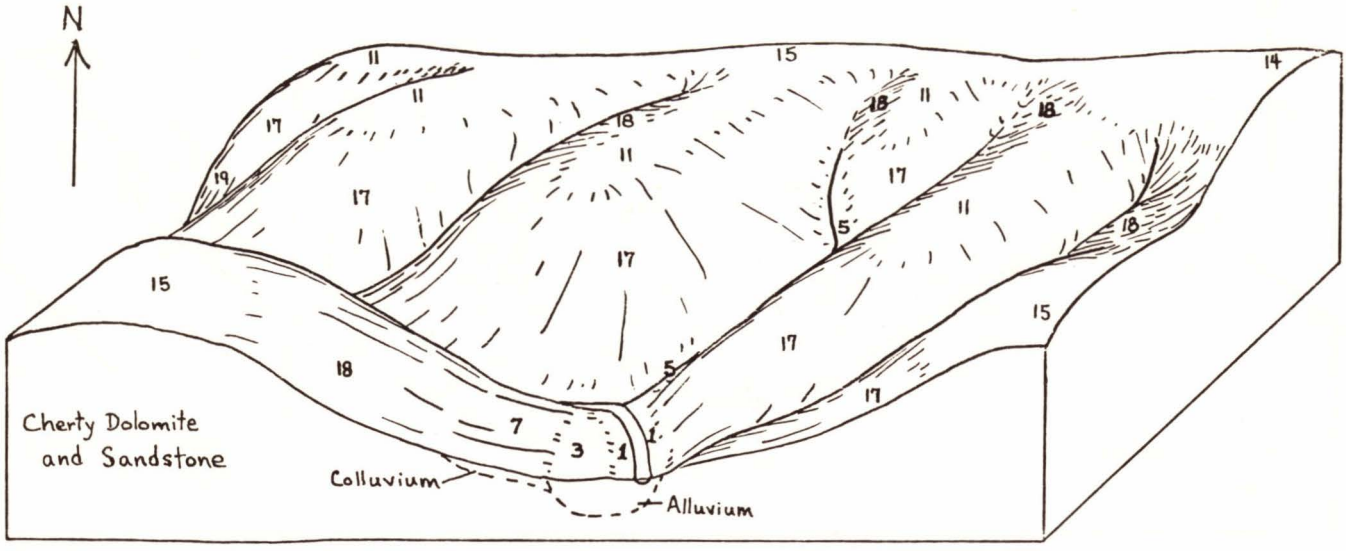


Figure 16. Oak-Pine Hills (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14, 10 - Ridges/deep cherty fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
22, 23 - Side slopes/very shallow soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

UPPER OZARK SUBSECTION

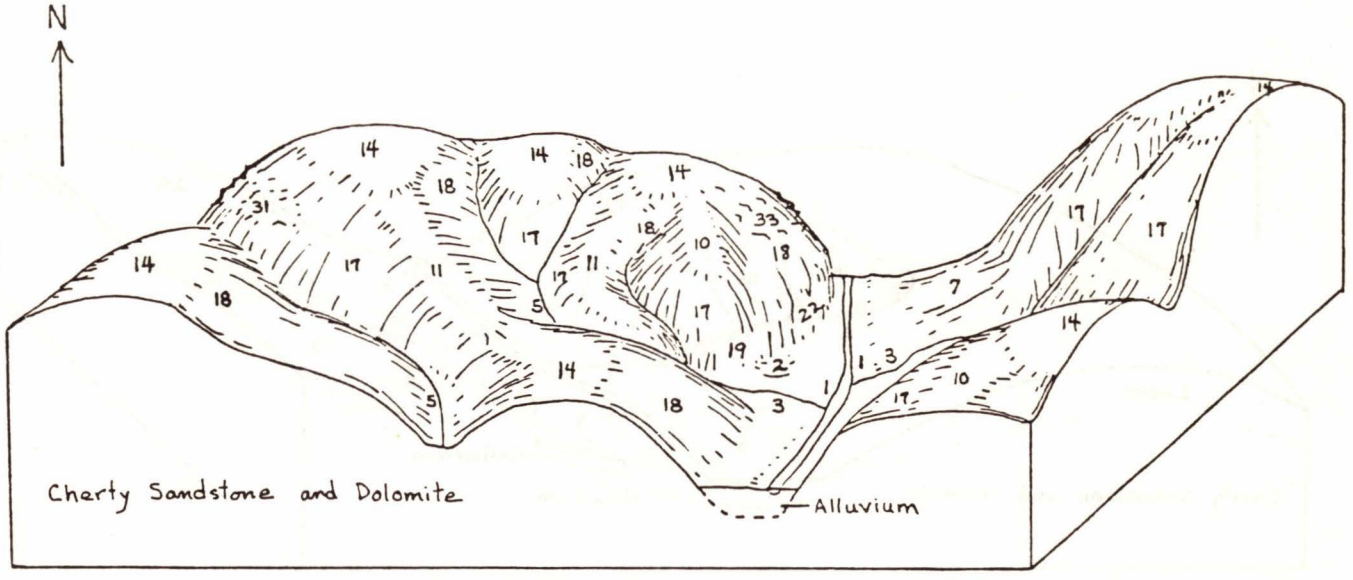


Figure 17. Oak-Pine Hills (Sandstone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
2 - High flood plains and low terraces/poorly drained soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14, 10 - Ridges/deep fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
21, 22, 23 - Side slopes/very shallow limestone soils.
31 - Side slopes, south and west aspect/very shallow sandstone soils.
33 - Side slopes, north and east aspect/very shallow sandstone soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

LOWER OZARK SUBSECTION

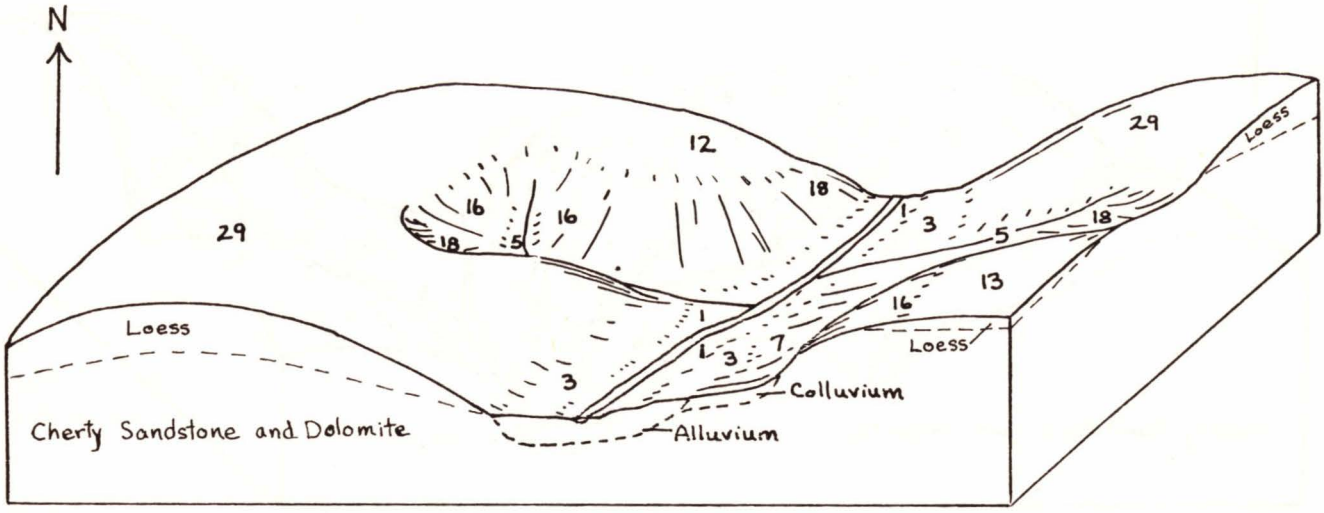


Figure 18. Oak-Hickory Hills (Loess) Landtype Association

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
9 - Narrow ridges/deep cherty fragipan soils.
12 - Ridges/deep cherty fragipan soils.
13 - Broad ridges/deep loamy and clayey soils.
16 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
29 - Broad ridges/deep loamy soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

LOWER OZARK SUBSECTION

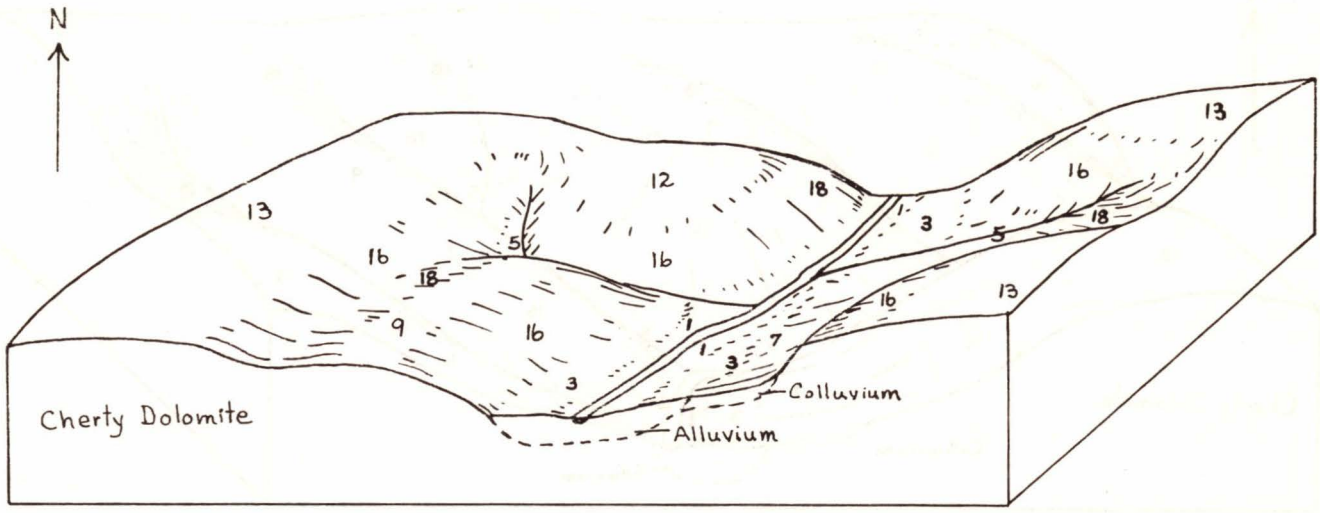


Figure 19. Oak-Hickory Plains (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
9 - Narrow ridges/deep cherty soils.
12 - Ridges/deep cherty fragipan soils.
13 - Broad ridges/deep loamy and clayey soils.
16 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

LOWER OZARK SUBSECTION

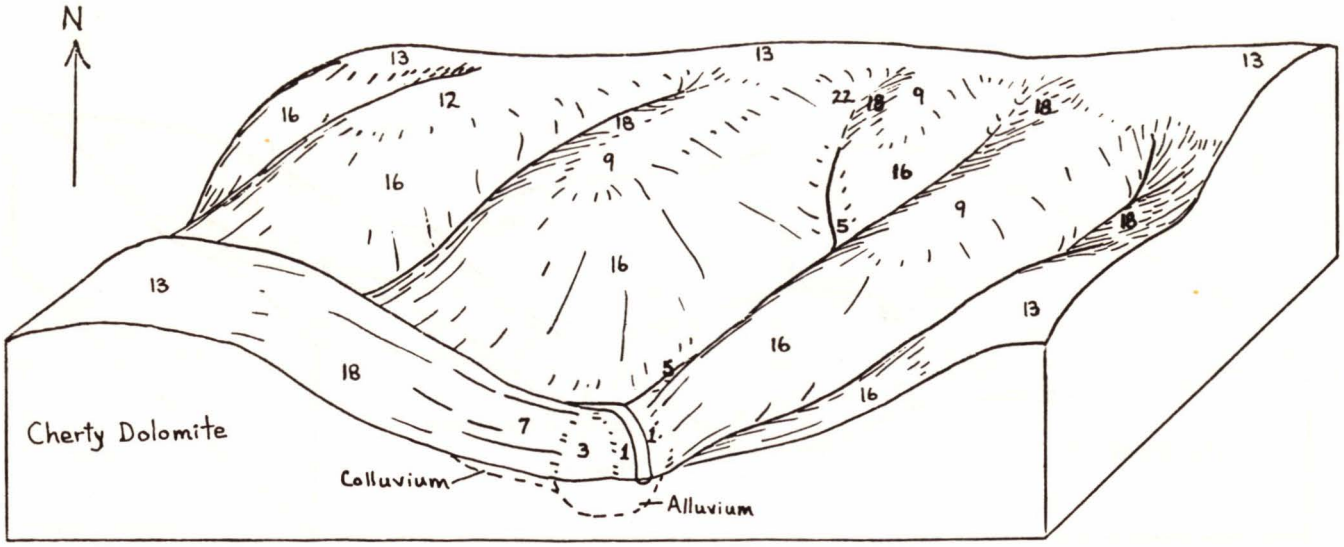


Figure 20. Oak-Hickory Hills (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
9 - Narrow ridges/deep cherty fragipan soils.
12 - Ridges/deep cherty fragipan soils.
13 - Broad ridges/deep loamy and clayey soils.
16 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
22 - Side slopes/very shallow soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

LOWER OZARK SUBSECTION

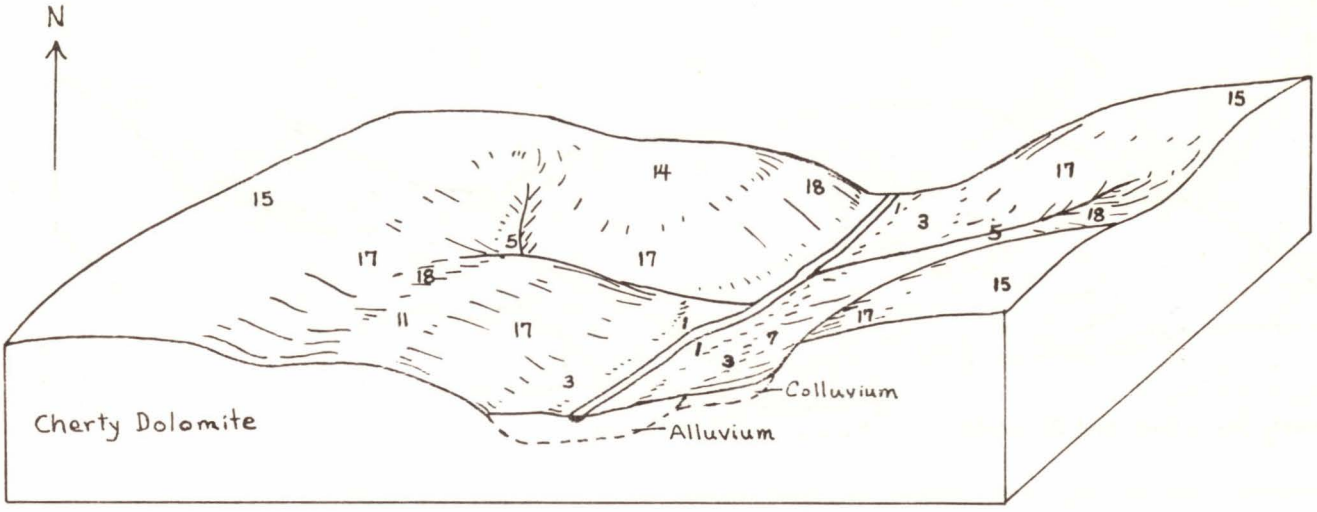


Figure 21. Oak-Pine Plains (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14 - Ridges/deep cherty fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

LOWER OZARK SUBSECTION

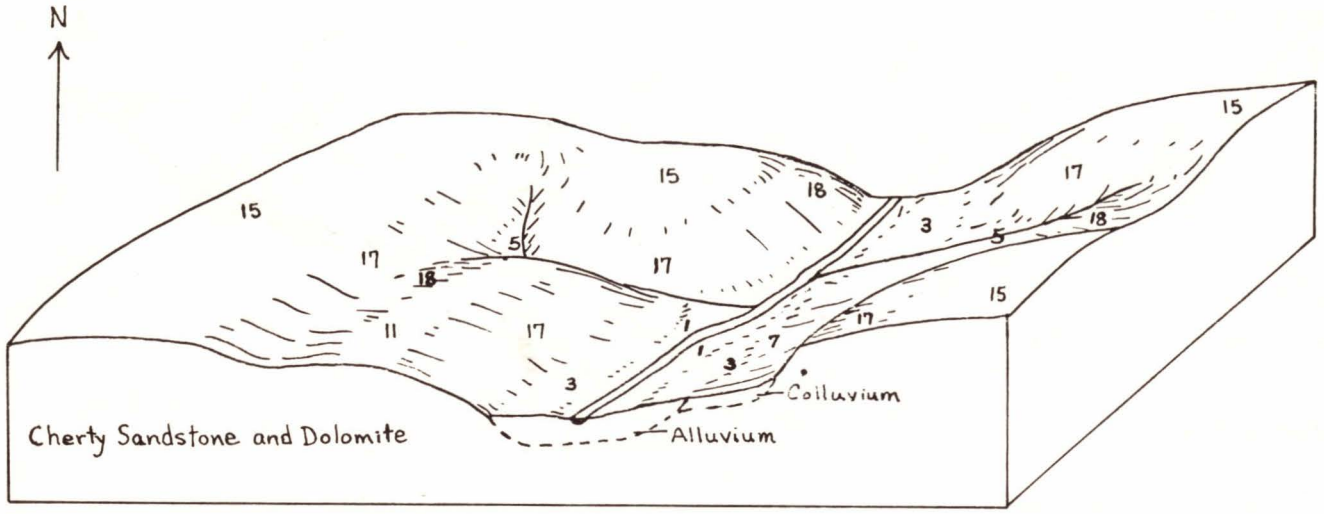


Figure 22. Oak-Pine Plains (Sandstone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14 - Ridges/deep cherty fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

LOWER OZARK SUBSECTION

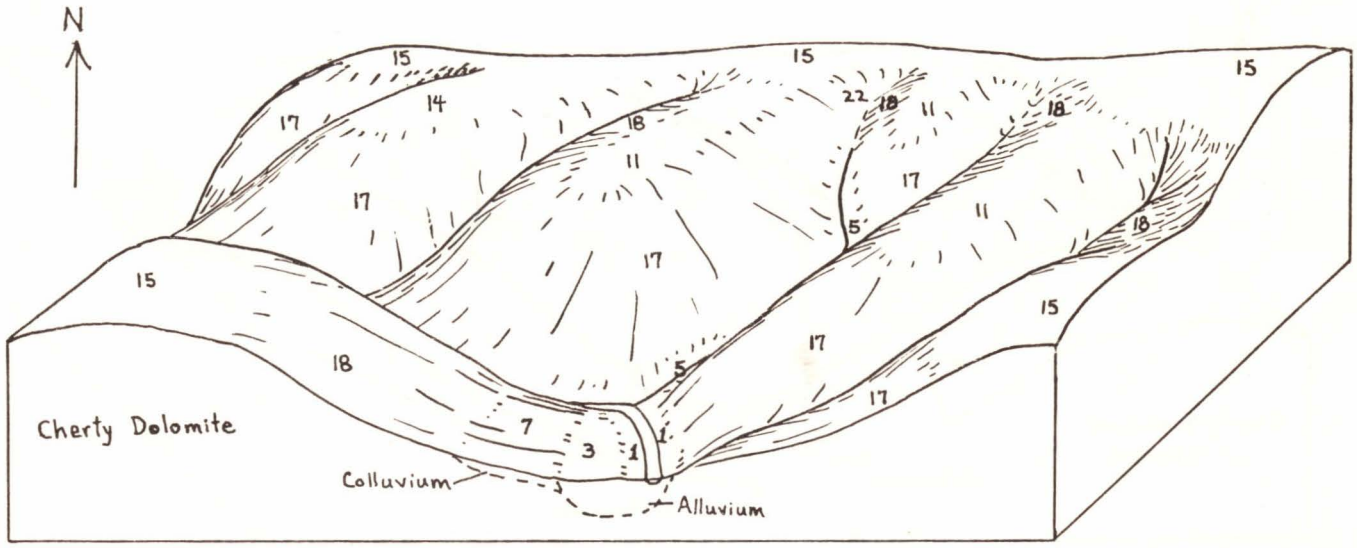


Figure 23. Oak-Pine Hills (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14 - Ridges/deep cherty fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
22 - Side slopes/very shallow soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

LOWER OZARK SUBSECTION

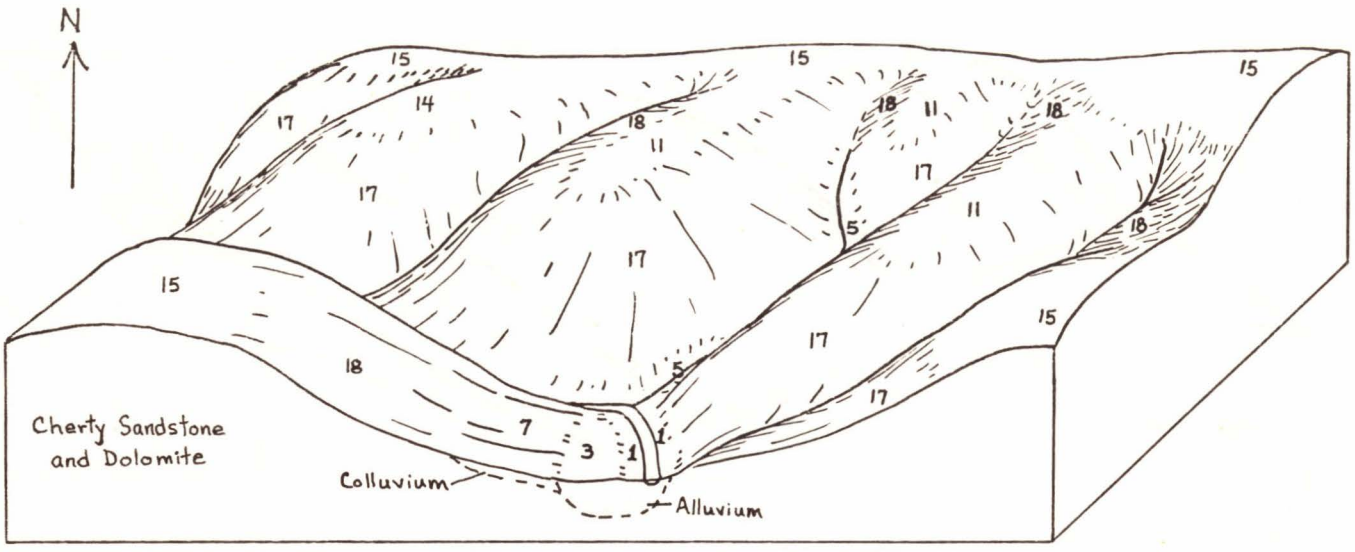


Figure 24. Oak-Pine Hills (Sandstone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14 - Ridges/deep cherty fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

LOWER OZARK SUBSECTION

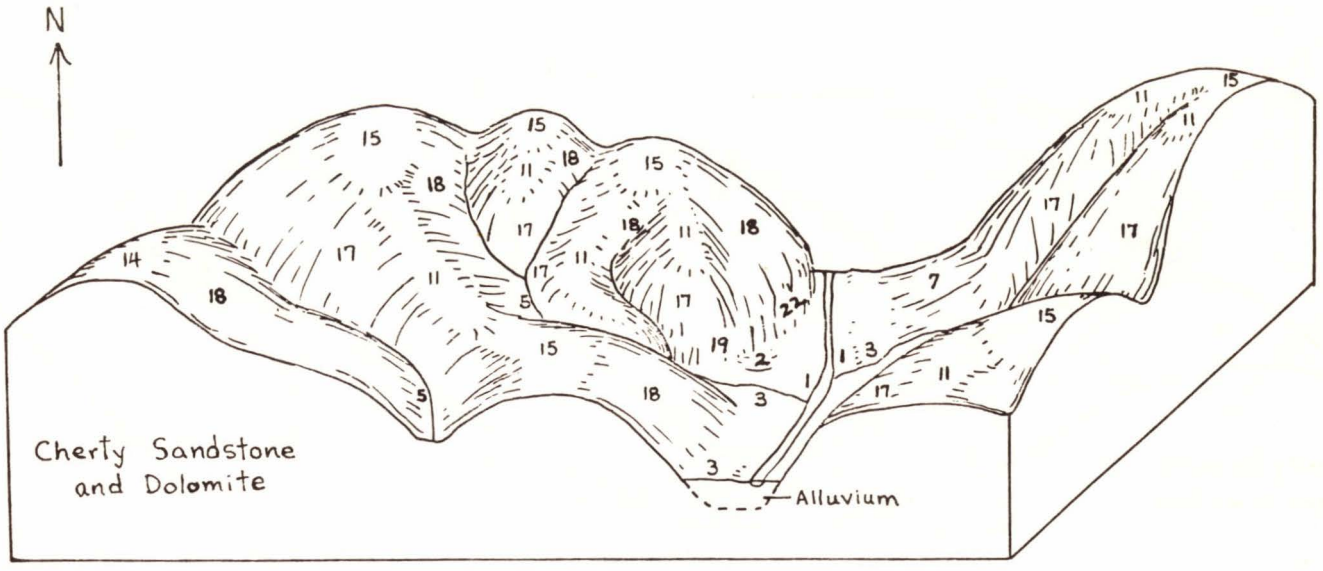


Figure 25. Oak-Pine Breaks (Sandstone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
2 - High flood plains and low terraces/poorly drained soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
11 - Narrow ridges/deep cherty soils.
14 - Ridges/deep cherty fragipan soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
21, 22, 23 - Side slopes/shallow soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

WHITE RIVER SUBSECTION

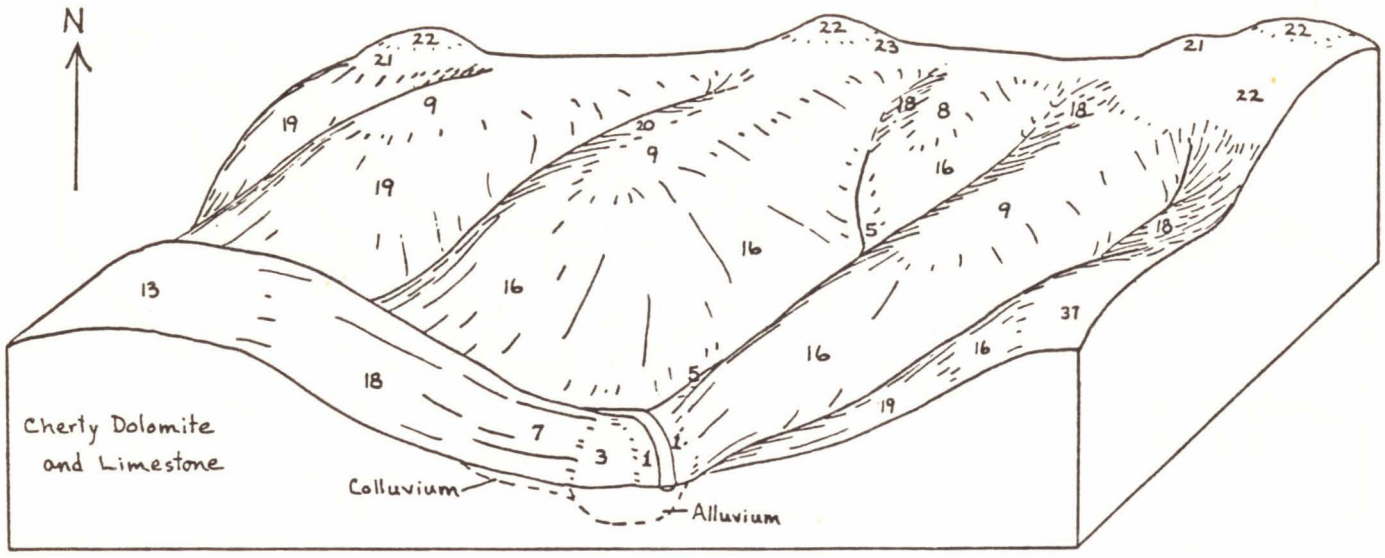


Figure 26. Cedar Glade Hills (Limestone) Landtype Association

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6, - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
8, 12 - Ridges/deep cherty fragipan soils.
13 - Broad ridges/deep loamy and clayey soils.
16 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
37 - Upland benches and terraces/deep soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

WHITE RIVER SUBSECTION

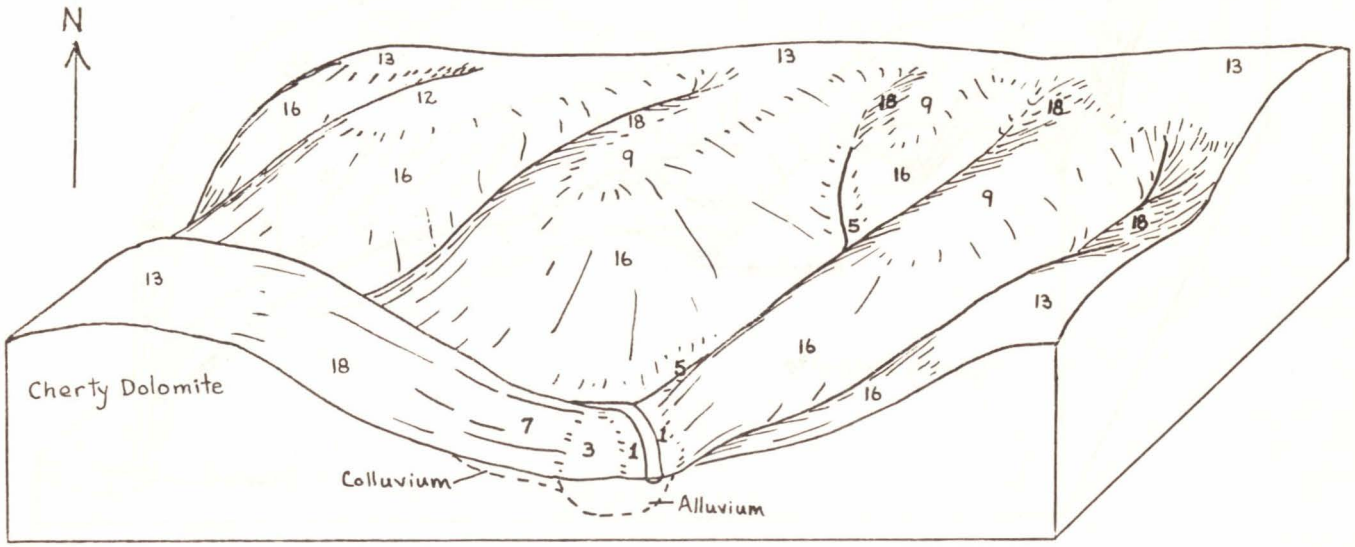


Figure 27. Oak-Hickory Hills (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
9 - Narrow ridges/deep cherty soils.
12 & 8 - Ridges/deep cherty fragipan soils.
13 - Broad ridges/deep loamy and clayey soils.
16 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
21, 22, 23 - Side slopes/very shallow soils (not shown).
37 - Upland benches and terraces/shallow soils (not shown).

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

WHITE RIVER SUBSECTION

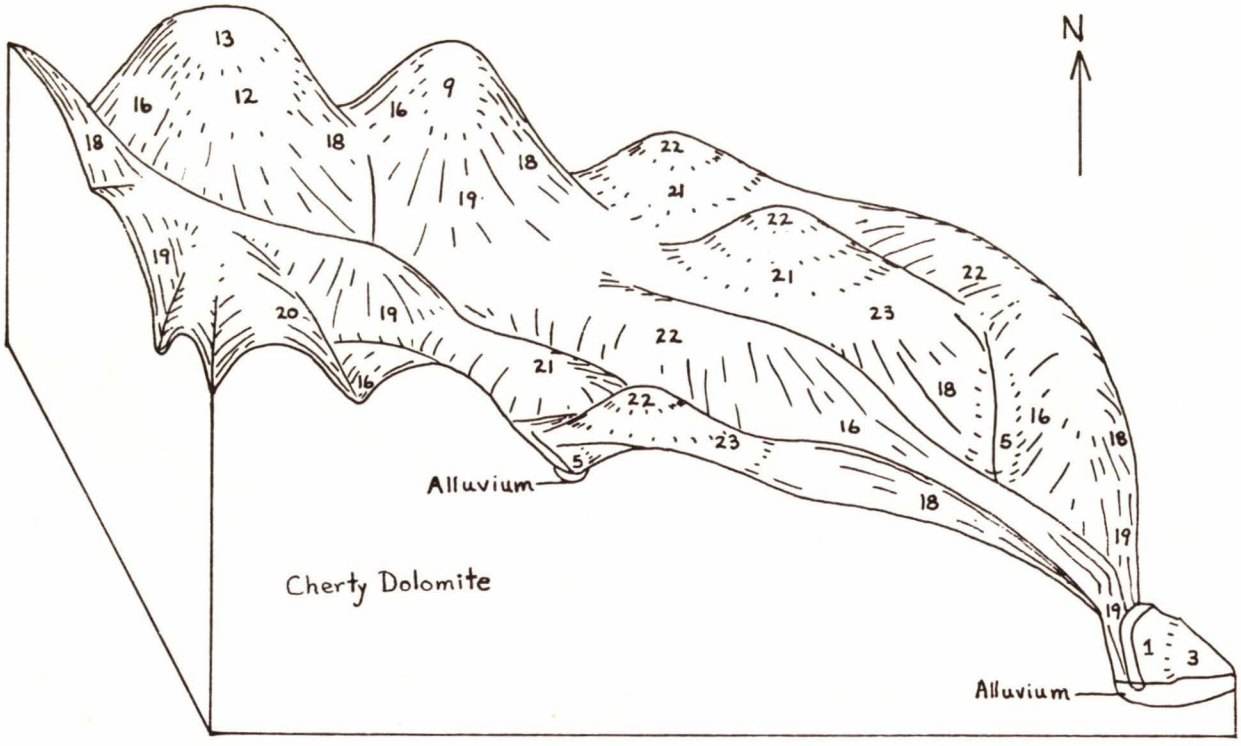


Figure 28. Cedar Glade Breaks (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
5 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
9 - Narrow ridges/deep cherty soils.
12 & 8 - Ridges/deep cherty fragipan soils.
13 - Broad ridges/deep loamy and clayey soils.
16 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
21, 22, 23 - Side slopes/very shallow soils.
37 - Upland benches and terraces/shallow soils (not shown).

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

WHITE RIVER SUBSECTION

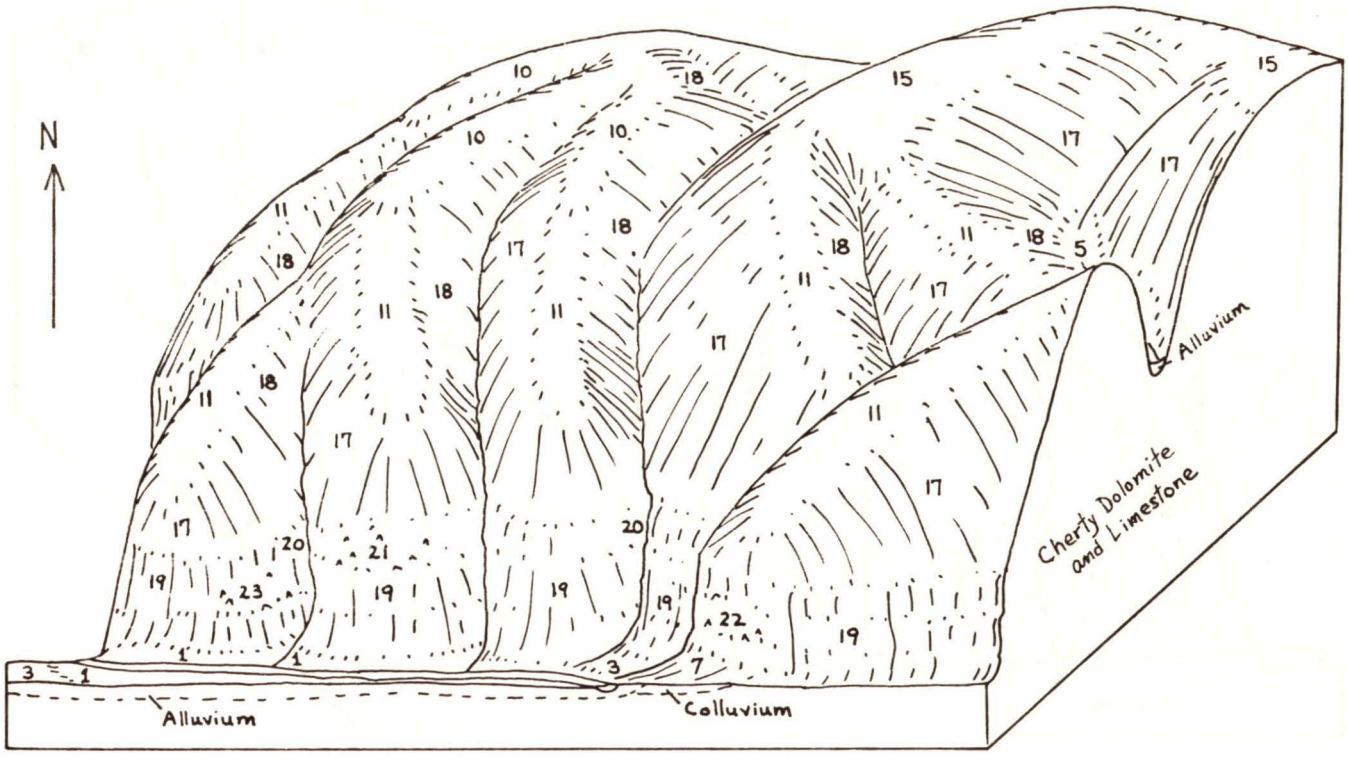


Figure 29. Oak-Pine Breaks (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
10, 14 - Ridges/deep cherty fragipan soils.
11 - Narrow ridges/deep cherty soils.
15 - Broad ridges/deep loamy and clayey soils.
17 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
21, 22, 23 - Side slopes/very shallow soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

WHITE RIVER SUBSECTION

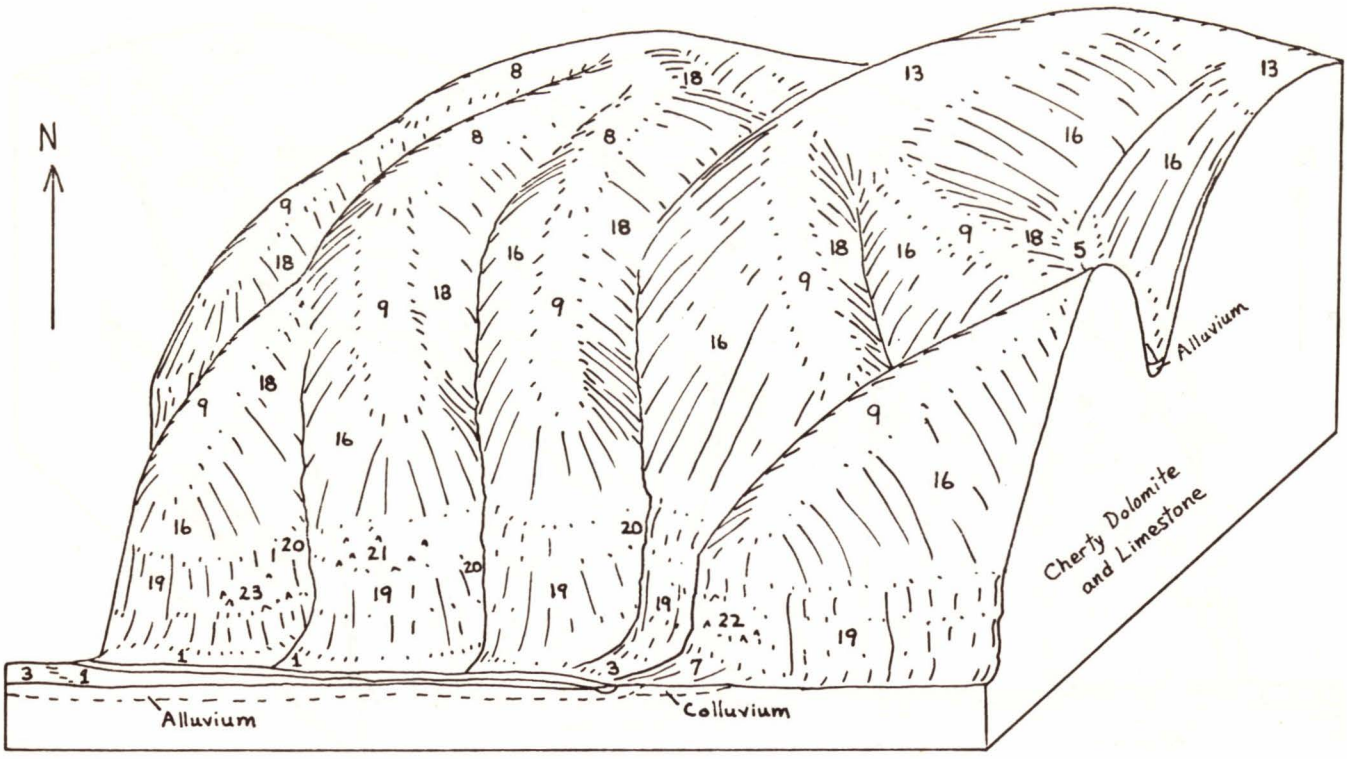


Figure 30. Oak-Hickory Breaks (Limestone) Landtype Association.

Ecological Landtypes:

1 - Low flood plains/loamy and mixed alluvial soils.
3 - High flood plains and low terraces/well drained soils.
4, 5, 6 - Upland waterways/deep cherty soils.
7 - Toe slopes/deep loamy soils.
8, 12 - Ridges/deep cherty fragipan soils.
9 - Narrow ridges/deep cherty soils.
13 - Broad ridges/deep loamy and clayey soils.
16 - Side slopes, south and west aspect/deep soils.
18 - Side slopes, north and east aspect/deep soils.
19 - Side slopes, south and west aspect/shallow soils.
20 - Side slopes, north and east aspect/shallow soils.
21, 22, 23 - Side slopes/very shallow soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

GLACIATED PLAINS SUBSECTION

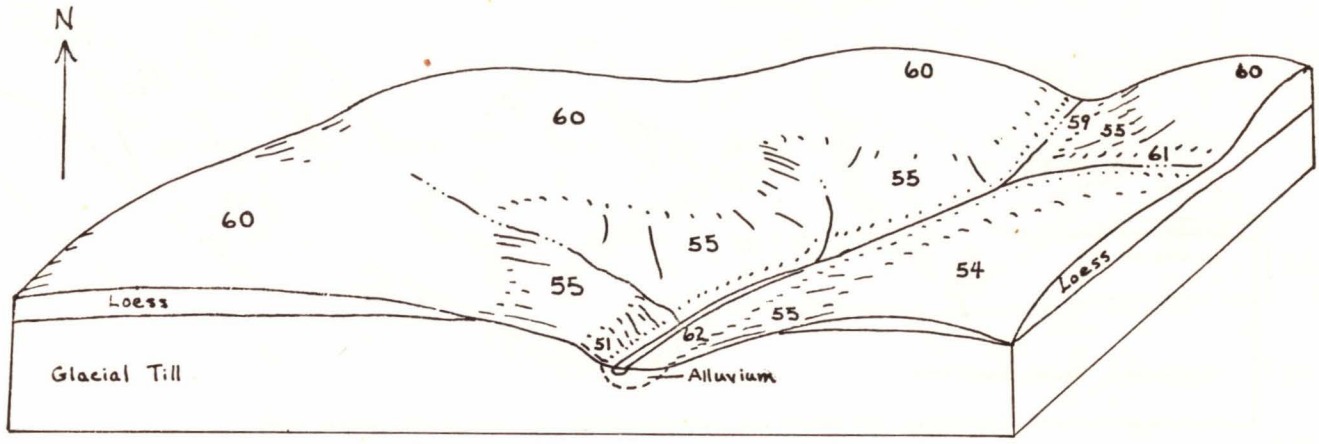


Figure 31. Oak-Bluestem Plains (Till) Landtype Association.

Ecological Landtypes:

51 - Side slopes/deep loamy soils.
52 - Side slopes, north and east aspect/deep cherty soils (not shown).
53 - Side slopes, south and west aspect/deep cherty soils (not shown).
54 - Ridges/deep clayey soils.
55 - Gentle upper slopes/deep clayey soils.
56 - Upland waterways/deep cherty soils (not shown).
58 - Toe slopes/deep loamy soils (not shown).
59 - Upland waterways/deep well drained soils.
60 - Broad ridges/deep somewhat poorly drained soils.
61 - Upland waterways/deep somewhat poorly drained soils.
62 - Flood plains/deep well drained soils.

TYPICAL ECOLOGICAL LANDTYPE PATTERNS

GLACIATED PLAINS SUBSECTION

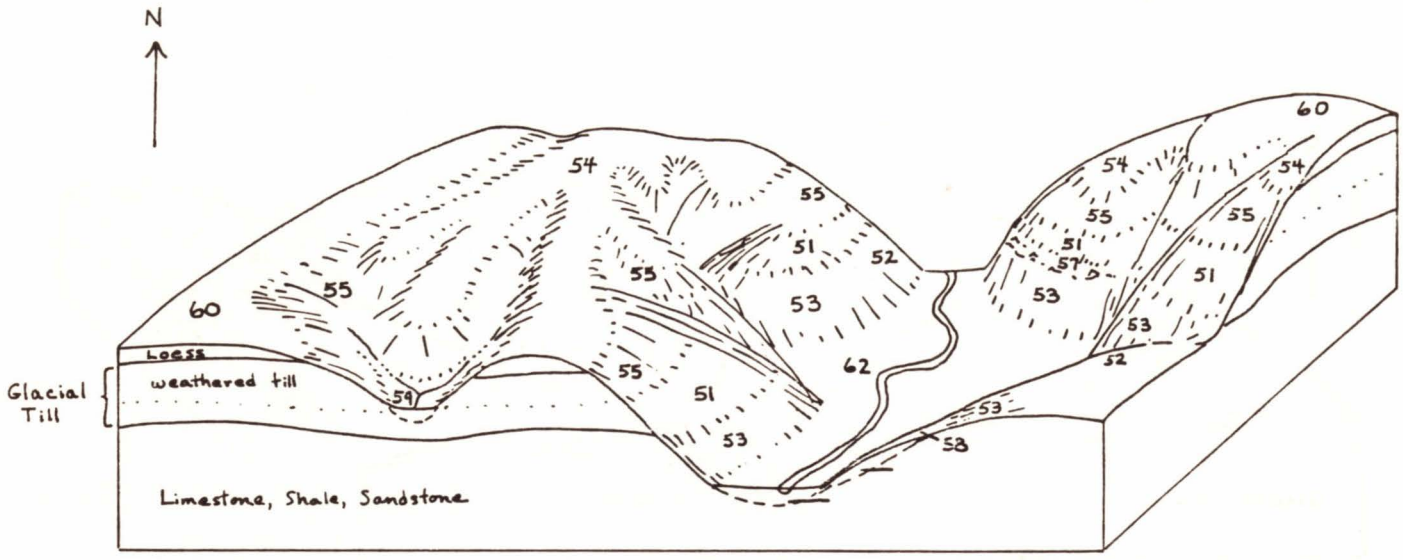


Figure 32. Oak-Hickory Hills (Till) Landtype Association.

Ecological Landtypes:

51 - Side slopes/deep loamy soils.
52 - Side slopes, north and east aspect/deep cherty soils.
53 - Side slopes, south and west aspect/deep cherty soils.
54 - Ridges/deep clayey soils.
55 - Gentle upper slopes/deep clayey soils.
56 - Upland waterways/deep cherty soils (not shown).
57 - Side slopes/very shallow soils.
58 - Toe slopes/deep loamy soils.
59 - Upland waterways/deep well drained soils.
60 - Broad ridges/deep somewhat poorly drained soils.
61 - Upland waterways/deep somewhat poorly drained soils (not shown).
62 - Flood plains/deep well drained soils.
63 - Ridges/deep loamy soils (not shown).
64 - Side slopes/deep loamy soils (not shown).

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